PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

Final Report
Investigation Results For
Perpich Center for Arts Education

Date: 5/31/2012

Minnesota Department of Education PCAE

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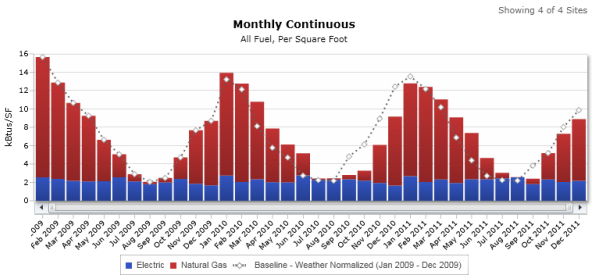
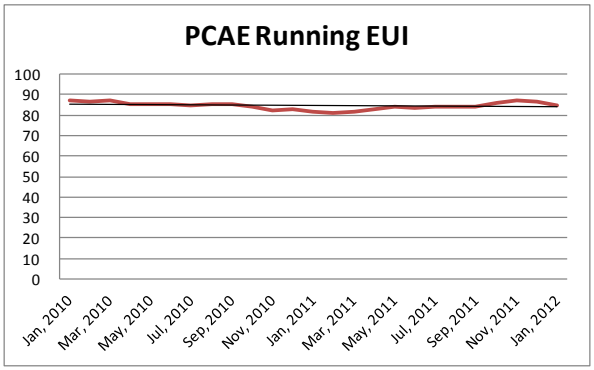
Perpich Center for Arts Education Energy Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. The investigation of Perpich Center for Arts Education was performed by Sebesta Blomberg, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$44,973		Total Project Cost	$110,219
Future costs including Implementation , Measurement & Verification	$65,246		Study and Administrative Cost Paid with ARRA Funds	($47,973)
Total Project Cost	$110,219		Utility Co-funding	$0
			Total costs after co-funding	$62,246
Estimated Annual Total Savings ($)	$21,731		Estimated Annual Total Savings ($)	$21,731
Total Project Payback	5.1		Total Project Payback with co-funding	3.0
Electric Energy Savings	**23 %**	**and**	**Natural Gas Savings**	**6.6%**





Year	Days	SF	Total kBtu	Normalized Baseline kBtu	Change from Baseline kBtu	% Change	Total Energy Cost $	Average Cost Rate $ /kBtu
2009	365	171,543	15,212,692	15,212,692	0	0%	$188,536.59	$0.01
2010	365	171,543	14,210,929	14,324,574	-113,645	-1%	$183,907.98	$0.01
2011	365	171,543	14,881,993	13,948,169	933,824	7%	$190,286.72	$0.01

Total energy use was unchanged during the period of the investigation

STATE OF MINNESOTA B3 BENCHMARKING

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Summary Tables

Perpich Center for Arts Education	
Location	6125 Olson Memorial Hwy Golden Valley, MN 55422
Facility Manager	Bill Nash Building Maintenance Foreman
Interior Square Footage	171,543
PBEEEP Provider	Sebesta Blomberg, Inc.
State's Project Manager	Ken Bronson
Annual Energy Cost	$ 190,287 (2011) Source: B3
Utility Company	Xcel Energy (Electric) Center Point Energy (gas)
Site Energy Use Index (EUI)	84 kBtu/ft^2 (at start of study) 86 kBtu/ft^2 (at end of study)
Benchmark EUI (from B3)	101 kBtu/ft^2

Building Name	State ID	Square Footage	Year Built
Administration Building	E2500000627 E2500000727	105,610	1965
Delta Dormitory	E2500000427	36,855	1979
Gaia Building	E2500000327	15,110	1970

	Mechanical Equipment Summary Table
Quantity	**Equipment Description**
1	Building Automation System (Automatrix)
3	Buildings
157,575	Interior Square Feet
23	Air Handlers
52	VAV Boxes
~65	Exhaust Fans
22	Unit Heaters and Cabinet Unit Heaters
13	Fan Coil Units
2	Chillers
2	Hot Water Boilers
2	Steam Boilers
20	Pumps (HW, CHW, etc)
2	Heat Exchangers
954	Points Available for Trending
415	Minimum Points to be Trended per PBEEEP Guidelines

Implementation Information			
Estimated Annual Total Savings ($)			$21,731
Total Estimated Implementation Cost ($)			$62,246
GHG Avoided in U.S Tons (CO2e)			306
Electric Energy Savings (kWh) 23.1 % Savings 2011 Electric Usage 1,356,120 kWh (from B3)			313,451
Electric Demand Savings (Peak kW)			34
Natural Savings (Therms) 6.6 % Savings 2011 Usage 102,549 Therms from B3			6,792
Statistics			
Number of Measures identified			7
Number of Measures with payback < 3 years			6
Screening Start Date	1/25/2011	Screening End Date	2/28/2011
Investigation Start Date	5/26/2011	Investigation End Date	4/30/2012
Final Report	5/31//2012		

Perpich Center for Arts Education Cost Information		
Phase	**To date**	**Estimated**
Screening	$3,330	
Investigation [Provider]	$34,950	
Investigation [CEE]	$6,693	$1,000
Implementation		$62,246
Implementation [CEE]		$1,000
Measurement & Verification	0	$1,000
Total	$44,973	$65,246

Co-funding Summary	
Study and Administrative Cost	$47,973
Utility Co-Funding - Estimated Total ($)	$
Total Co-funding ($)	$47,973

Facility Overview

The energy investigation identified 11.8% of total energy savings at Perpich Center for Arts Education with measures that payback in less than 15 years and do not adversely affect occupant comfort. The energy savings opportunities identified at Perpich Center for Arts Education are based on adjusting the schedule of equipment to match actual building occupancy hours, adding a VFD to control an air handler fan, adjusting economizer lockout temperatures, and adding a programmable thermostat in the Gaia Building. The total cost of implementing all the measures is $62,246.

Implementing all these measures can save the facility approximately $21,731 a year with a combined payback period of 2.9 years before rebates based on the implementation cost only (excluding study and administrative costs). These measures will produce 23.1 % electrical savings and 6.6 % natural gas savings. The building is currently performing at 15% below the Minnesota Benchmarking and Beyond database (B3) benchmark; energy usage during the period of the study increased by about 1%.

The primary energy intensive systems at Perpich Center for Arts Education are described here:

The Perpich Center for Arts Education serves nearly 300 11th and 12th graders approximately half of whom live on campus. It is comprised of four buildings totaling 171,543 square feet. The largest building on campus is the Administration Building, where the majority of offices and classrooms are located. The Administration Building has two wings, East and West. The East wing was built in 1965 and the West wing was added on in 1998. Delta Dormitory provides housing for 130 students. The Gaia Building has additional office space and classrooms. The Alpha Building is a warehouse that is in the process of being torn down.

Mechanical Equipment

The Administration Building has two low pressure steam boilers that provide 10 psi steam to the East Wing and the Gaia Building. A heat exchanger converts heat from the steam to hot water that is then circulated to the West Wing. Five air handlers serve the West Wing, two of which are variable volume and serve Variable Air Volume (VAV) boxes. Thirteen constant volume air handlers serve the East Wing. The East Wing also has perimeter steam radiation. Two chillers provide chilled water to fifteen of the air handlers during the spring, summer, and fall. One air handler has Direct eXpansion (DX) cooling and two air handlers do not have cooling.

The Delta Dormitory has three constant volume air handlers with DX cooling and hot water heat that serve the corridors and common areas. One boiler provides hot water to the air handlers and perimeter radiation. Another boiler provides domestic hot water for the bathrooms. There are approximately 50 exhaust fans, one for each bathroom.

The Gaia Building gets steam from the Administration Building. The steam is used in the air handlers and a heat exchanger converts heat from the steam to hot water for the perimeter radiation. Two air handlers with steam heat and DX cooling serve the Southern end of the building. The Northern end is heated by perimeter radiation and thirteen hot water Cabinet Unit Heaters (CUHs) and it is cooled by thirteen Fan Coil Units (FCUs).

Controls and Trending

The equipment in the Administration Building and portions of Delta Dormitory and the Gaia Building are controlled by an Automatrix Building Automation System (BAS). The BAS is capable for trending and the trend data can be exported in a usable format for spreadsheet calculations. There is digital actuation and control throughout the Administration Building except for the perimeter radiation that serves the South side of the East Wing and the East Wing Library. The radiation in those areas is controlled by pneumatic thermostats. Some of the perimeter radiation on the North side of the East Wing is controlled by manual thermostats. The air handlers in the Delta Dormitory are controlled by the BAS, but the boilers, exhaust fans, and cabinet unit heaters are not; they have stand-alone or manual control. Both air handlers in the Gaia Building are controlled by the BAS. The fan coil units and cabinet unit heaters are on local control and the hot water valves in the Gaia Building are controlled pneumatically.

Lighting

The majority of interior lighting on campus is 32 watt T8s. There are occupancy sensors in Delta Dormitory and in the restrooms of the East Wing of the Administration Building. The West Wing corridors of the Administration Building are controlled by the BAS. The remaining lights throughout the buildings are controlled by manual switches.

Energy Use Index and B3 Benchmark

The Administration Building provides steam to the Gaia Building, so the energy use of the two buildings cannot be separated. The site Energy Use Index (EUI) for both buildings is 94 kBtu/sqft, which is 7% lower than their B3 Benchmark of 101 kBtu/sqft. The Delta Dormitory has an EUI of 95 kBtu/sqft, which is 27% lower than its B3 Benchmark of 130 kBtu/sqft.

The median site EUI for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks. This indicates that the Perpich Center has the potential to further reduce its energy use.

Metering

The Administration Building has one electric and one natural gas meter. Delta Dormitory also has one of each meter type and the Gaia Building has one electric meter only, because it gets steam from the Administration Building.

Findings Summary

Site: Perpich Center

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
3	Administration East and West	AHU Scheduling	$1,890	$11,785	0.16	$0	0.16	165
11	Administration East and West	Exhaust Fan Scheduling	$300	$809	0.37	$0	0.37	13
1	Gaia Building	Manual T-Stats control fan coil units.	$870	$1,015	0.86	$0	0.86	16
1	Delta Dormitory	AHU-DS1, DS2, DS3 operate 24/7	$991	$595	1.67	$0	1.67	9
12	Administration East and West	AHU-1 DAT is higher than needed.	$300	$174	1.73	$0	1.73	1
7	Administration East and West	AHU Economizer lockout set to 60-65F. MAT setpoints are not ideal.	$11,495	$3,891	2.95	$0	2.95	45
1	Administration East and West	AHUs S-1, S-2, S-3, S-6, S-8, S-9, and S-11	$46,400	$3,463	13.40	$0	13.40	56
		Total for Findings with Payback 3 years or less:	**$15,846**	**$18,268**	**0.87**	**$0**	**0.87**	**250**
		Total for all Findings:	**$62,246**	**$21,731**	**2.86**	**$0**	**2.86**	**306**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Perpich Center

Finding Type Number	Finding Type	Relevant Findings	Looked for, Not found	Not relevant
a.1 (1)	Time of Day enabling is excessive	3		
a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	2	1	
a.3 (3)	Lighting is on more hours than necessary.		3	
a.4 (4)	OTHER_Equipment Scheduling/Enabling	1	2	
b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position,	3		
b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design	3		
b.3 (7)	OTHER_Economizer/OA Loads	1		
c.1 (8)	Simultaneous Heating and Cooling is present and excessive	2	1	
c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	3		
c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	1	1	
c.4 (11)	OTHER_Controls			
d.1 (12)	Daylighting controls or occupancy sensors need optimization.		2	
d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	2		
d.3 (14)	Fan Speed Doesn't Vary Sufficiently	1	1	
d.4 (15)	Pump Speed Doesn't Vary Sufficiently	1		1
d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary		1	1
d.6 (17)	Other_Controls (Setpoint Changes)	1	1	1
e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	1		1
e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal		1	1
e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	1	1	
e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal		1	1

e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			2
e.6 (22)	Other_Controls (Reset Schedules)			
f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit		1	1
f.2 (24)	Pump Discharge Throttled	1		1
f.3 (25)	Over-Pumping		1	1
f.4 (26)	Equipment is oversized for load.		1	1
f.5 (27)	OTHER_Equipment Efficiency/Load Reduction			1
g.1 (28)	VFD Retrofit - Fans	1		1
g.2 (29)	VFD Retrofit - Pumps	1		
g.3 (30)	VFD Retrofit - Motors (process)			2
g.4 (31)	OTHER_VFD			1
h.1 (32)	Retrofit - Motors		1	1
h.2 (33)	Retrofit - Chillers		2	
h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)		1	1
h.4 (35)	Retrofit - Boilers		1	1
h.5 (36)	Retrofit - Packaged Gas fired heating			2
h.6 (37)	Retrofit - Heat Pumps			2
h.7 (38)	Retrofit - Equipment (custom)			2
h.8 (39)	Retrofit - Pumping distribution method		1	1
h.9 (40)	Retrofit - Energy/Heat Recovery			2
h.10 (41)	Retrofit - System (custom)			2
h.11 (42)	Retrofit - Efficient Lighting		2	
h.12 (43)	Retrofit - Building Envelope		2	
h.13 (44)	Retrofit - Alternative Energy	1		1
h.14 (45)	OTHER_Retrofit		2	
i.1 (46)	Differed Maintenance from Recommended/Standard		1	1

i.2 (47)	Impurity/Contamination		1	
i.3 ( )	Leaky/Stuck Damper		1	
i.4 ( )	Leaky/Stuck Valve		1	
i.5 (48)	OTHER_Maintenance	1		
j.1 (49)	OTHER			

Findings Glossary: Findings Examples

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**
	• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**
	• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**
	• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**
	• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**
	• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**
	• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**
	• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**
	• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**
	• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**
	• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**
	• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**
	• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**
	• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**
	• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**
	• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**
	• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**
	• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**
	• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**
	• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**
	• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**
	• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**
	• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**
	• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**
	• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**
	• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**
	• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**
	• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**
	• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**
	• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**
	• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**
	• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**
	• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**
	• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**
	• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**
	• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**
	• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**
	• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**
	• Please contact PBEEEP Project Engineer for approval

Findings Summary

Building: Administration East and West

Site: Perpich Center

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
3	AHU Scheduling	$1,890	$11,785	0.16	$0	0.16	165
11	Exhaust Fan Scheduling	$300	$809	0.37	$0	0.37	13
12	AHU-1 DAT is higher than needed.	$300	$174	1.73	$0	1.73	1
7	AHU Economizer lockout set to 60-65F. MAT setpoints are not ideal.	$11,495	$3,891	2.95	$0	2.95	45
1	AHUs S-1, S-2, S-3, S-6, S-8, S-9, and S-11	$46,400	$3,463	13.40	$0	13.40	56
	Total for Findings with Payback 3 years or less:	**$13,985**	**$16,658**	**0.84**	**$0**	**0.84**	**224**
	Total for all Findings:	**$60,385**	**$20,121**	**3.00**	**$0**	**3.00**	**281**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Administration East and West

FWB Number:	15301	Eco Number:	1
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	AHUs S-1, S-2, S-3, S-6, S-8, S-9, and S-11	Date Identified:	10/20/2011
Description of Finding:	These air handlers are constant volume and are currently providing more space conditioning than required. An indication of over conditioning is that the site staff have scheduled some units off while spaces are occupied and on when the spaces are unoccupied. This was done at the request of the space users. User complaints were described as too much air from the diffusers, space is too cold (cooling season), and air noise. Also the spaces served by these air handlers have finned-tube radiation for heating which allows for significant fan turn down in the heating season. These units can be converted to variable volume by adding a VFDs to the fans.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Variable Frequency Drives (VFD)
Finding Type:	VFD Retrofit - Fans		

Implementer:	Contractor: Electrical/Controls	Benefits:	reduced energy usage, improved air quality, improved occupant comfort
Baseline Documentation Method:	Site investigation, construction drawing review and staff interviews. Trending of AHU fan status, space temperature, heating/cooling valves, and outdoor conditions.		
Measure:	Install a VFD to control the fan speed.		
Recommendation for Implementation:	Applies to AHUs S-1, S-2, S-3, S-6, S-8, S-9, and S-11 Install a Variable Frequency Drive (VFD) on the fan motor and provide programming for control of the VFD. Fan speed to be modulated based on space temperature. A constant discharge air temperature setpoint to be established for heating and cooling seasons and be adjustable at BAS computer. As the space temperature changes the VFD shall modulate up or down to achieve the space temperature setpoint. Modulate outdoor air dampers to maintain minimum ventilation requirement. -Field verify motor size, and actual amperage use for VFD selection. -Select drives in accordance with applicable engineering standards. -All new drives shall be equipped with line bypass so that fans may continue to operate if the VFD fails. -VFD to be located as close to unit as possible. For installations greater than 100 feet, output filters shall be provided with drive package. -Drive location shall be selected to be compatible with manufacture recommendations (cool, dry and adequate ventilation). -Provide VFD startup services making adjustments as necessary; provide operator training. -Provide control points of status, speed, and override capability at the BAS.		
Evidence of Implementation Method:	VFD equipment submittal and completed startup documentation. Minimum of 3 weeks trending of fan status, fan speed, DAT, heating and cooling valve positions, and space temperature/setpoint. Trending interval to be 15 minutes or less.		

Annual Electric Savings (kWh):	66,986	Peak Demand Savings (kWh):	30
Estimated Annual kWh Savings ($):	$3,586	Estimated Annual Demand Savings ($):	$0
Annual Natural Gas Savings (therms):	-169	Contractor Cost ($):	$38,840
Estimated Annual Natural Gas Savings ($):	$-123	PBEEEP Provider Cost for Implementation Assistance ($):	$7,560
		Total Estimated Implementation Cost ($):	$46,400

Estimated Annual Total Savings ($):	$3,463	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	13.40	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	13.40	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	56	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	15.9%	Percent of Implementation Costs:	74.5%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Administration East and West

FWB Number:	15301	Eco Number:	3
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	AHU Scheduling	Date Identified:	11/1/2011
Description of Finding:	Trending review of the AHUs operating schedules revealed many which are operating either 24/7 or hours which are excessive compared to space occupancy.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	In house staff	Benefits:	Improved occupant comfort, air quality and energy savings
Baseline Documentation Method:	Trending review, review of BAS and operator interviews		
Measure:	Change programmed schedule to reflect space occupancy/loads.		
Recommendation for Implementation:	AHU scheduling to match occupancy schedule for the zones served. Proposed AHU schedules for during the school year are S-1: 6:00am-4:00pm, S-2: 6:00am-8:00pm, S-3: 6:00am-6:00pm M-F, 6:00am-10:00am Sat-Sun, S-4: 6:00am-6:00pm normal occupied mode, 6:00pm-6:00am operate with OA damper minimum set to 0%, S-5: 6:00am-6:00pm, S-6: 6:00am-8:00pm, S-7: 6:00am-6:00pm, S-8: 6:00am-6:00pm, S-9: 6:00am-6:00pm, S-10: 6:00am-6:00pm, S-11: 6:00am-8:00pm. West side AHUs: AHU2: 6:00am-8:00pm, AHU3: 6:00am-8:00pm, AHU4: 6:00am-9:00pm. When areas have occupancy outside of normal hours only schedule the necessary AHUs on and for only the days when an event occurs.		
Evidence of Implementation Method:	Trending of fan status and zone temperature. Minimum of 3 weeks trending at a max interval of 15 min. Screen shots of AHU schedules in the BAS.		

Annual Electric Savings (kWh): Estimated Annual kWh Savings ($):	167,493 $8,966	Peak Demand Savings (kWh): Estimated Annual Demand Savings ($):	1 $0
Annual Natural Gas Savings (therms): Estimated Annual Natural Gas Savings ($):	3,867 $2,819	Contractor Cost ($): PBEEEP Provider Cost for Implementation Assistance ($): Total Estimated Implementation Cost ($):	$0 $1,890 $1,890

Estimated Annual Total Savings ($): Initial Simple Payback (years): Simple Payback w/ Utility Co-Funding (years): GHG Avoided in U.S. Tons (C02e):	$11,785 0.16 0.16 165	Utility Co-Funding for kWh ($): Utility Co-Funding for kW ($): Utility Co-Funding for therms ($): Utility Co-Funding - Estimated Total ($):	$0 $0 $0 $0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	54.2%	Percent of Implementation Costs:	3.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Administration East and West

FWB Number:	15301	Eco Number:	7
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	AHU Economizer lockout set to 60-65F. MAT setpoints are not ideal.	Date Identified:	1/26/2012
Description of Finding:	Many AHU economizer lockout setpoints are 60-65F. Based on DAT setpoints a high lockout will provide additional free cooling. This includes AHUs S-1, S-2, S-3, S-4, S-5, S-6, S-7, S-8, S-9, S-10, S-1, AHU-2, AHU-3, and AHU-4 Also the MAT are not maintained to the ideal setpoint based on supply air temperature.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Economizer Operation - Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)		

Implementer:	Contractor: Controls	Benefits:	Reduced energy use by cooling plant.
Baseline Documentation Method:	Trending of mixed air damper and economizer setpoints, during all seasons.		
Measure:	Set economizer lockout to 70F. And control MAT based on DAT required.		
Recommendation for Implementation:	Change Economizer lockout temperature setpoint to 70 deg. F. Apply to AHUs S-1, S-2, S-3, S-4, S-5, S-6, S-7, S-8, S-9, S-10, S-11, AHU-2, AHU-3, and AHU-4. Also, program economizer to control MAT based on DAT setpoint to minimize heating and cooling that can be achieved using the economizer. To accomplish this a single loop control strategy for maintaining discharge air temperature. The single loop control performs as follows: For economizer enable/disable, compare the outdoor air enthalpy (as calculated from the outdoor air dry bulb temperature and outdoor air humidity) with the return air enthalpy (as calculated from return air dry bulb temperature and return air humidity). If the outdoor air enthalpy is less than the return air enthalpy (with a 2 BTU/lb dead band) the economizer shall be enabled. The heating section, economizer dampers (if economizer is enabled) and cooling section shall be modulated in series, without overlap, to maintain the discharge air temperature set point.		
Evidence of Implementation Method:	Minimum of 3 weeks trending during a shoulder season. Points to be trended include fan status, mixed air damper position, OAT, RAT, MAT, DAT, DAT setpoint and economizer lockout setpoint. Trend interval to be 15 minutes or less.		

Annual Electric Savings (kWh):	34,434	Peak Demand Savings (kWh):	3
Estimated Annual kWh Savings ($):	$1,843	Estimated Annual Demand Savings ($):	$0
Annual Natural Gas Savings (therms):	2,808	Contractor Cost ($):	$9,605
Estimated Annual Natural Gas Savings ($):	$2,047	PBEEEP Provider Cost for Implementation Assistance ($):	$1,890
		Total Estimated Implementation Cost ($):	$11,495

Estimated Annual Total Savings ($):	$3,891	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	2.95	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	2.95	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	45	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	17.9%	Percent of Implementation Costs:	18.5%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Administration East and West

FWB Number:	15301	Eco Number:	11
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	Exhaust Fan Scheduling	Date Identified:	3/22/2012
Description of Finding:	Several exhaust fans operate beyond normal occupancy for the areas served. These fans include: E-1, E-8, E-9, E-10, PRV-1, EF-1, EF-2, and Kiln Exh.		
Equipment or System(s):	Other	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	In house staff	Benefits:	Reduced electricity use by exhaust fans.
Baseline Documentation Method:	Trending of fan amps showed operating schedules which exceed building occupancy schedules.		
Measure:	Change programmed schedule to reflect space occupancy.		
Recommendation for Implementation:	Change exhaust fan scheduling to match space occupancy. This applies to exhaust fans E-1, E-8, E-9, E-10, PRV-1, EF-1, EF-2, and Kiln Exh.		
Evidence of Implementation Method:	Trending of exhaust fan status Minimum of 3 weeks trending at a max interval of 15 min. Screen shots of EF schedules from the BAS.		

Annual Electric Savings (kWh):	15,111	Contractor Cost ($):	$165
Estimated Annual kWh Savings ($):	$809	PBEEEP Provider Cost for Implementation Assistance ($):	$135
		Total Estimated Implementation Cost ($):	$300

Estimated Annual Total Savings ($):	$809	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.37	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.37	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	13	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.7%	Percent of Implementation Costs:	0.5%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Administration East and West

FWB Number:	15301	Eco Number:	12
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	AHU-1 DAT is higher than needed.	Date Identified:	3/22/2012
Description of Finding:	AHU-1 supplies makeup air to the boiler room. Due to the operation of the boilers the space temperature remains above 80F during all hours. The DAT could be lowered and the space will continue to maintain a space temperature above 68F.		
Equipment or System(s):	AHU with heating only	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	In house staff	Benefits:	Natural gas savings due to reduced steam consumption
Baseline Documentation Method:	Trending of AHU-1 DAT and space temperature sensors.		
Measure:	Change DAT setpoint during the heating season to 55F.		
Recommendation for Implementation:	Change DAT setpoint from 60F to 55F during the heating season. The boiler room remained at 80F during all hours of trending during the heating season.		
Evidence of Implementation Method:	Trending of DAT setpoint during the heating season. Minimum of 3 weeks trending at a max interval of 15 minutes.		

Annual Natural Gas Savings (therms):	238	Contractor Cost ($):	$165
Estimated Annual Natural Gas Savings ($):	$174	PBEEEP Provider Cost for Implementation Assistance ($):	$135
		Total Estimated Implementation Cost ($):	$300

Estimated Annual Total Savings ($):	$174	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.73	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.73	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	1	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.8%	Percent of Implementation Costs:	0.5%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Summary

Building: Delta Dormitory
Site: Perpich Center

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	AHU-DS1, DS2, DS3 operate 24/7	$991	$595	1.67	$0	1.67	9
	Total for Findings with Payback 3 years or less:	**$991**	**$595**	**1.67**	**$0**	**1.67**	**9**
	Total for all Findings:	**$991**	**$595**	**1.67**	**$0**	**1.67**	**9**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Delta Dormitory

FWB Number:	15302	Eco Number:	1
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	AHU-DS1, DS2, DS3 operate 24/7	Date Identified:	10/21/2011
Description of Finding:	Trending of fan amps shows the AHU fans operating 24/7. Staff interviews revealed systems run during the summer months to remedy dehumidification issues.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Controls contractor	Benefits:	Energy savings due to reduced run hours
Baseline Documentation Method:	Trending of the fan amps point demonstrates an amp draw during the whole trending period.		
Measure:	During unoccupied summer months change operating schedule to cycle the AHUs based on space temp and humidity setpoints		
Recommendation for Implementation:	Program unoccupied mode for AHU DS1, DS2, and DS3. Unoccupied mode shall cycle AHUs on and off based on adjustable space temperature and humidity setpoints. Setpoints to be 78 Deg F, 65% RH. Better building operation will result if summer unoccupied schedule closes the OA dampers when fans/DX run.		
Evidence of Implementation Method:	Trending of Fan amps, Space temp, Space humidity, and outside air temp during unoccupied summer months. Trending duration to be a minimum of three weeks at a sampling interval of 15 minutes or less.		

Annual Electric Savings (kWh):	10,458	Annual Natural Gas Savings (therms):	48
Estimated Annual kWh Savings ($):	$560	Estimated Annual Natural Gas Savings ($):	$35
Contractor Cost ($):	$545		
PBEEEP Provider Cost for Implementation Assistance ($):	$446		
Total Estimated Implementation Cost ($):	$991		

Estimated Annual Total Savings ($):	$595	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.67	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.67	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	9	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.7%	Percent of Implementation Costs:	1.6%

Findings Summary

Building: Gaia Building
Site: Perpich Center

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	Manual T-Stats control fan coil units.	$870	$1,015	0.86	$0	0.86	16
	Total for Findings with Payback 3 years or less:	**$870**	**$1,015**	**0.86**	**$0**	**0.86**	**16**
	Total for all Findings:	**$870**	**$1,015**	**0.86**	**$0**	**0.86**	**16**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Gaia Building

FWB Number:	15303	Eco Number:	1
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	Manual T-Stats control fan coil units.	Date Identified:	8/11/2011
Description of Finding:	Manually controlled thermostats are used to control all of the fan coil units in the building. All of them were found to be set on Cool, fan in auto, and a setpoint between 70-72°F. This setpoint is higher than the state required cooling setpoint of 74-76°F.		
Equipment or System(s):	AHU with cooling only	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Other_Controls (Setpoint Changes)		

Implementer:	In-house staff or contractor to install.	Benefits:	Reduced electrical usage
Baseline Documentation Method:	Observed Thermostat settings during multiple walkthroughs.		
Measure:	Install 7 day programmable thermostats on fan coil units		
Recommendation for Implementation:	Purchase and install a programmable thermostat for each fan coil unit. The thermostat shall have 7 day scheduling and setback capability. Keypad shall have locking capability which prevents all, but site engineers from changing the setpoints. Initial schedule to be Monday through Friday 6AM to 6PM. Cooling setpoint to be 74-76F, setback of 80F.		
Evidence of Implementation Method:	Functional testing to verify correct installation of thermostat: change space temperature setpoints to activate and deactivate the unit. Provide photographs showing new thermostat and each setpoint schedule.		

Annual Electric Savings (kWh):	18,969	Contractor Cost ($):	$600
Estimated Annual kWh Savings ($):	$1,015	PBEEEP Provider Cost for Implementation Assistance ($):	$270
		Total Estimated Implementation Cost ($):	$870

Estimated Annual Total Savings ($):	$1,015	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.86	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.86	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	16	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	4.7%	Percent of Implementation Costs:	1.4%

PBEEEP State Government

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15301 - Perpich Ctr-Administration Building

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	Applys to FWB 3	BAS		AHUs are not scheduled as expected. Units operate for extended periods of time when spaces are unoccupied.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	Applys to FWB 3	BAS		AHUs are not scheduled as expected. Units operate for extended periods of time when spaces are unoccupied.
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	Lighting is on 16 hours. Occupancy sensors and site staff interviews indicate lights are off when spaces are not used.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling	FWB 9	Spaces with FTR		The east side of the buildings primary heating source is finned-tube-radiation which is controled by pnuematic t-stats/actuators.
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	Investigating			
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	Investigating			Waiting for winter trends
	b.3 (7)	OTHER_Economizer/OA Loads	Investigating			Waiting for winter trends
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	FWB 5	S-5		AHU S-5 demonstrated simultaneous heating during shoulder season trends when OAT was 50-55F
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	Investigating			
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Investigation looked for, but did not find this issue.	No occ sensors.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	Investigating			Some heating setpoints found to be 70-71F
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	FWB 3			Units are constant volume and can be retrofit with VFDs
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently	Investigating			
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Investigation looked for, but did not find this issue.	VAV controller calculates required airflow based on space temp
	d.6 (17)	Other_Controls (Setpoint Changes)			Investigation looked for, but did not find this issue.	
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	To be investigated during heating season			
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	No cooling towers
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Investigation looked for, but did not find this issue.	
	f.2 (24)	Pump Discharge Throttled	Investigating			
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Not Relevant	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction			Not Relevant	
	g.1 (28)	VFD Retrofit - Fans	Applys to FWB 1-12	Mech. Spaces		AHUs S-1 through S-12 are all constant volume and could be retrofit with a VFD to be variable volume.

PBEEEP State Government

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15301 - Perpich Ctr-Administration Building

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps	Investigating			
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD			Not Relevant	
h. Retrofits:	h.1 (32)	Retrofit - Motors			Investigation looked for, but did not find this issue.	Motors are all relatively new and are in excellent condition.
	h.2 (33)	Retrofit - Chillers			Investigation looked for, but did not find this issue.	New chiller already in place.
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not Relevant	
	h.4 (35)	Retrofit - Boilers			Investigation looked for, but did not find this issue.	Boilers have been re-tubed and are well maintained.
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	
	h.7 (38)	Retrofit - Equipment (custom)			Not Relevant	
	h.8 (39)	Retrofit - Pumping distribution method			Investigation looked for, but did not find this issue.	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	Energy recovery unit already in place.
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting			Investigation looked for, but did not find this issue.	
	h.12 (43)	Retrofit - Building Envelope			Investigation looked for, but did not find this issue.	
	h.13 (44)	Retrofit - Alternative Energy	Repair Energy Recovery Unit			Currently investigating fix for ERU.
	h.14 (45)	OTHER_Retrofit				
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Investigation looked for, but did not find this issue.	
	i.2 (47)	Impurity/Contamination			Investigation looked for, but did not find this issue.	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance	FWB 6	Steam System		Steam traps have not been checked for several years. At a minimum these should be checked annually. A survey of the system will most likely reveal some failed steam traps.
j. OTHER	j.1 (49)	OTHER				

Investigation Checklist

PBEEEP State Government

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15302 - Perpich Ctr-Delta Dorm

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	FWB #1	DS1, DS2, DS3		These RTUs condition the dorm 24/7 all year and could have a reduced operating schedule during the summer when the building is unoccupied.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	FWB #1	DS1, DS2, DS3		These RTUs condition the dorm 24/7 all year and could have a reduced operating schedule during the summer when the building is unoccupied.
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	
	a.4 (4)	OTHER_Equipment Scheduling/Enabling			Investigation looked for, but did not find this issue.	
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	FWB #3	DS1, DS2, DS3		The RTUs do not have full economizer capability and trending showed no OA damper modulation.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	FWB #3	DS1, DS2, DS4		The RTUs do not have full economizer capability and trending showed no OA damper minimum positions to be higher than required for minimum ventilation based on occupancy and space type.
	b.3 (7)	OTHER_Economizer/OA Loads				
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Investigation looked for, but did not find this issue.	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	FWB #4	DS3		Space temperature readings were not as close to recorded return air temperatures as expected.
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints				
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.				
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.				
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently				
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently				
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary				
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal				
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal				
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal				
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal				
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit				
	f.2 (24)	Pump Discharge Throttled				
	f.3 (25)	Over-Pumping				
	f.4 (26)	Equipment is oversized for load.				
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				

PBEEEP State Government

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15302 - Perpich Ctr-Delta Dorm

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.1 (28)	VFD Retrofit - Fans				
	g.2 (29)	VFD Retrofit - Pumps				
	g.3 (30)	VFD Retrofit - Motors (process)				
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				
	h.2 (33)	Retrofit - Chillers				
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)				
	h.4 (35)	Retrofit - Boilers				
	h.5 (36)	Retrofit - Packaged Gas fired heating				
	h.6 (37)	Retrofit - Heat Pumps				
	h.7 (38)	Retrofit - Equipment (custom)				
	h.8 (39)	Retrofit - Pumping distribution method				
	h.9 (40)	Retrofit - Energy/Heat Recovery				
	h.10 (41)	Retrofit - System (custom)				
	h.11 (42)	Retrofit - Efficient Lighting				
	h.12 (43)	Retrofit - Building Envelope				
	h.13 (44)	Retrofit - Alternative Energy				
	h.14 (45)	OTHER_Retrofit				
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard				
	i.2 (47)	Impurity/Contamination				
	i.3 ( )	Leaky/Stuck Damper				
	i.4 ( )	Leaky/Stuck Valve				
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

Investigation Checklist

PBEEEP State Government

Rev. 2.0 (12/16/2010)

15303 - Perpich Ctr-Gaia

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	FWB-1	All FCUs		All fan coil units have single setpoint manual thermostats
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive			Investigation looked for, but did not find this issue.	
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	
	a.4 (4)	OTHER_Equipment Scheduling/Enabling			Investigation looked for, but did not find this issue.	
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	Investigating			winter trends to be evaluated to verify function
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	Investigating			winter trends to be evaluated to verify function
	b.3 (7)	OTHER_Economizer/OA Loads				
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	FWB-2	AHU GS13		Steam valve opens while DX cooling is active
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	FWB-1			Replace FCU manual t-stats
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	FWB 5,6	AHU GS13 and GS14		AHUs have a space temperature setpoint which is programmed incorrectly. Instead of maintaining the space setpoint the AHUs are providing a DAT which matches the space setpoint.
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Investigation looked for, but did not find this issue.	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	FWB-1	FCUs		Manual t-stats do not allow for setup/setback
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	No VFDs in this building
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not Relevant	No Pumps in this building
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Not Relevant	No VAVs in this building
	d.6 (17)	Other_Controls (Setpoint Changes)	FWB-1	FCUs		Most FCUs are set to 71F
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	FWB 5,6			AHUs are controlling to a single DAT setpoint which happens to be the space temperature setpoint. This causes space over cooling and over heating.
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Not Relevant	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	AHUs utilize DX cooling.
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not Relevant	
	f.2 (24)	Pump Discharge Throttled			Not Relevant	
	f.3 (25)	Over-Pumping			Not Relevant	
	f.4 (26)	Equipment is oversized for load.			Investigation looked for, but did not find this issue.	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

15303 - Perpich Ctr-Gaia

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				
g. Variable Frequency Drives (VFD):	g.1 (28)	VFD Retrofit - Fans			Not cost-effective to investigate	
	g.2 (29)	VFD Retrofit - Pumps				
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Investigation looked for, but did not find this issue.	All packaged units are relatively new.
	h.4 (35)	Retrofit - Boilers			Not Relevant	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not Relevant	
	h.7 (38)	Retrofit - Equipment (custom)			Not Relevant	
	h.8 (39)	Retrofit - Pumping distribution method			Not Relevant	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting			Investigation looked for, but did not find this issue.	Building has T-8 lighting. Space use is limited and site staff says lights are not left on.
	h.12 (43)	Retrofit - Building Envelope			Investigation looked for, but did not find this issue.	No obvious issues with the walls or roof, windows are double pane do not appear to have leaks (no moisture between panes).
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	Building has sees limited use.
	h.14 (45)	OTHER_Retrofit				
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Investigation looked for, but did not find this issue.	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper				
	i.4 ( )	Leaky/Stuck Valve				
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

Deleted Findings Summary

Site: Perpich Center

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	Administration East and West	Admin S-4 is constant volume.	$0	$0	0.00	$0	0.00	0
4	Administration East and West	Energy Recovery Unit not in use.	$0	$0	0.00	$0	0.00	0
5	Administration East and West	S-5 Simultaneous Heating and cooling.	$0	$0	0.00	$0	0.00	0
6	Administration East and West	Steam System Maintenance	$0	$0	0.00	$0	0.00	0
8	Administration East and West	The Automatrix SAGE MAX BAS is out of date and no longer supported by Automatrix.	$0	$0	0.00	$0	0.00	0
9	Administration East and West	Finned-Tube Radiation is controlled by pneumatic thermostats.	$0	$0	0.00	$0	0.00	0
10	Administration East and West	Heating Water reset is not functioning as designed.	$0	$0	0.00	$0	0.00	0
2	Delta Dormitory	AHU-DS1, DS2, DS3 are not fully integrated into the BAS.	$0	$0	0.00	$0	0.00	0
3	Delta Dormitory	AHU- DS1 DS2 and DS3 supply 50% outside air at all times.	$0	$0	0.00	$0	0.00	0
4	Delta Dormitory	AHU-DS3 T-Stat reading incorrect.	$0	$0	0.00	$0	0.00	0
2	Gaia Building	AHU GS13 simultaneous heating and cooling.	$0	$0	0.00	$0	0.00	0
3	Gaia Building	AHU GS13 Cooling setpoint is 70 F	$0	$0	0.00	$0	0.00	0
4	Gaia Building	AHU GS13 Economizer operation not fully economizing.	$0	$0	0.00	$0	0.00	0

Deleted Findings Summary

Site: Perpich Center

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
5	Gaia Building	AHU GS13 heating setpoint is 71.	$0	$0	0.00	$0	0.00	0
		Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
		Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

Deleted Findings Summary

Building: Administration East and West

Site: Perpich Center

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	Admin S-4 is constant volume.	$0	$0	0.00	$0	0.00	0
4	Energy Recovery Unit not in use.	$0	$0	0.00	$0	0.00	0
5	S-5 Simultaneous Heating and cooling.	$0	$0	0.00	$0	0.00	0
6	Steam System Maintenance	$0	$0	0.00	$0	0.00	0
8	The Automatrix SAGE MAX BAS is out of date and no longer supported by Automatrix.	$0	$0	0.00	$0	0.00	0
9	Finned-Tube Radiation is controlled by pneumatic thermostats.	$0	$0	0.00	$0	0.00	0
10	Heating Water reset is not functioning as designed.	$0	$0	0.00	$0	0.00	0
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Administration East and West

FWB Number:	15301	Eco Number:	2
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	Admin S-4 is constant volume.	Date Identified:	10/20/2011
Description of Finding:	This air handler is constant volume and is currently providing more space conditioning than required. This unit can be converted to variable volume by adding a VFD to the fan. Finding deleted. Payback is beyond 15 years.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Contractor: Electrical/Controls	Benefits:	reduced energy usage, improved air quality, improved occupant comfort
Baseline Documentation Method:	Site investigation, construction drawing review and staff interviews.		
Measure:	Install a VFD to control the fan speed.		
Recommendation for Implementation:	Install a Variable Frequency Drive (VFD) on the fan motor and provide programming for control of the VFD. Fan speed to be modulated based on space temperature. A constant discharge air temperature setpoint to be established for heating and cooling seasons and be adjustable at BAS computer. As the space temperature changes the VFD shall modulate up or down to achieve the space temperature setpoint. Modulate outdoor air damper to maintain minimum ventilation requirement. -Field verify motor size, and actual amperage use for VFD selection. -Select drives in accordance with applicable engineering standards. -All new drives shall be equipped with line bypass so that fans may continue to operate if the VFD fails. -VFD to be located as close to unit as possible. For installations greater than 100 feet, output filters shall be provided with drive package. -Drive location shall be selected to be compatible with manufacture recommendations (cool, dry and adequate ventilation). -Provide VFD startup services making adjustments as necessary; provide operator training. -Provide control points of status, speed, and override capability at the BAS. -Provide and install Humidity sensor in the library. Program High Humidity alarm point of 60% (adjust.).		
Evidence of Implementation Method:	VFD equipment submittal and completed startup documentation. Minimum of 3 weeks trending of fan status, fan speed, DAT, heating and cooling valve positions, and space temperature/setpoint. Trending interval to be 15 minutes or less.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

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Deleted Findings Details

Building: Administration East and West

FWB Number:	15301	Eco Number:	4
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	Energy Recovery Unit not in use.	Date Identified:	11/1/2011
Description of Finding:	Energy recovery unit needs repair and is not in operation. Currently investigating what repairs are needed.		
Equipment or System(s):	Other	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:		Benefits:	
Baseline Documentation Method:	Site observations during summer and shoulder investigation and staff interviews.		
Measure:	Repair unit and put into operation. DURING THE WINTER SEASON THIS ERU WAS REPAIRED AND PUT INTO OPERATION. THIS IS NO LONGER AN ISSUE.		
Recommendation for Implementation:			
Evidence of Implementation Method:			

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details

Building: Administration East and West

FWB Number:	15301	Eco Number:	5
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	S-5 Simultaneous Heating and cooling.	Date Identified:	1/1/2012
Description of Finding:	Shoulder season trends indicate unit is simultaneously heating and cooling the discharge air. Trends show both heating and cooling valves operating at the same time. This occurred several times during the month of October and was consistently happening during times when the outside air temperature was between 50-55 deg F. Due to the payback greater than 15 years this item is not included in the PBEEEP portion of this work and is deleted from the findings workbook.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Contractor: Controls	Benefits:	Reduced heating and cooling energy use.
Baseline Documentation Method:	Shoulder season trends of heating and cooling valves.		
Measure:	Repair heating and cooling valve control sequences.		
Recommendation for Implementation:	Provide programming for the heating and cooling valves which prevents both from modulating at the same time. One valve shall be closed before the other can modulate open.		
Evidence of Implementation Method:	Minimum of 3 weeks trending of fan status, DAT, heating and cooling valve positions. Trending interval to be 15 minutes or less.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Administration East and West

FWB Number:	15301	Eco Number:	6
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	Steam System Maintenance	Date Identified:	1/26/2012
Description of Finding:	Based on conversations with site staff it was determined the existing steam traps in the system have not been checked since installed. Also, the age of the traps is unknown. As part of a preventative maintenance program steam traps should be checked. Due to the unknown condition of the steam existing steam traps this measure is deleted from the PBEEEP portion of this work. A steam trap survey is still recommended as a preventative maintenance item to be done annually.		
Equipment or System(s):	Boiler Plant	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Contractor or in house staff.	Benefits:	Reduced energy use by the boiler plant.
Baseline Documentation Method:	Site Staff interviews. No known steam trap surveys have been conducted.		
Measure:	Perform a survey of all steam traps on campus.		
Recommendation for Implementation:	Survey all steam traps and repair/replace failed traps.		
Evidence of Implementation Method:	Provide photos/description of failed trap and photos/description of new trap/installation after replacement.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details

Building: Administration East and West

FWB Number:	15301	Eco Number:	8
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	The Automatrix SAGE MAX BAS is out of date and no longer supported by Automatrix.	Date Identified:	1/26/2012
Description of Finding:	The existing Automatrix SAGE MAX Building Automation System has reached the end of its useful life. The following are some of the most notable issues with this BAS. -This system/software is no longer supported by American Auto-Matrix. -The current system has little trending/troubleshooting capability. -The existing trending setup and download process is very tedious/time consuming and unreliable. -Limited product support from local control providers. -HVAC system upgrades which require programming changes cannot be made easily. -Many control points are not correct. For example many AHUs discharge air at temps equal to the space temp setpoint. Due to the uncertainty of savings associated with upgrading the BAS this measure is deleted from the PBEEEP findings workbook. Even though this measure does not meet the PBEEEP requirements for implementation it is a necessary upgrade. The reliability of the existing system will continue to degrade and the cost to repair systems with obsolete BAS control will continue to increase rapidly each year.		
Equipment or System(s):	Other	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Contractor: Controls	Benefits:	Reduced energy use. Improved occupant comfort. Reduced maintenance costs.
Baseline Documentation Method:	First hand use of BAS, interviews/interaction with site staff, and discussions with control system providers.		
Measure:	Replace front end BAS with new.		
Recommendation for Implementation:	It is recommended that the site pursue the BAS upgrade offered by Egan to upgrade the system the American Auto-Matrix's the "Matrix" system. Contracted work should at a minimum include 1.New area controller and Matrix Software. 2.New Graphics, including point to point verification from device to BAS. 3.Web access. 4.Advanced Trend capability, including operator training. 5.Alarm notification. 6. Operator training for all BAS pages.		
Evidence of Implementation Method:	Control system as-built drawings. Documentation of point-to-point checks. Commissioning of all systems on new BAS.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details

Building: Administration East and West

FWB Number:	15301	Eco Number:	9
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	Finned-Tube Radiation is controlled by pneumatic thermostats.	Date Identified:	1/26/2012
Description of Finding:	All of the finned-tube radiation in the Administration building is controlled by local pneumatic thermostats. This results in the space setpoints remaining at the same value 24/7 during the heating months.		
Equipment or System(s):	Other	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Contractor: Controls	Benefits:	Reduced steam use during unoccupied hours. Improved space heating control.
Baseline Documentation Method:	Building walkthrough observations of finned-tube radiation and pneumatic control. Building construction drawings.		
Measure:	Replace pneumatic thermostats and actuators with DDC.		
Recommendation for Implementation:	DDC control of finned tube radiation would allow for night setback operation during the heating season. Due to the high capital cost of this improvement it is not recommended at this time.		
Evidence of Implementation Method:			

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details

Building: Administration East and West

FWB Number:	15301	Eco Number:	10
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	Heating Water reset is not functioning as designed.	Date Identified:	3/22/2012
Description of Finding:	The existing HHW reset is designed such that at 60F OAT the HHW supply temp is 60F and at 0F OAT the HHW supply temp is 150F. The HHW supply temp setpoint is calculated linearly between the two at the outside air temperatures that fall between 0-60F. The HHW supply temp is not following this reset at all. The HHW appears to be controlling to the Return temperature but not to a setpoint determined by the HHW reset. The HHW return temp is maintained at 113F during all outside air conditions. Also the HHW supply temp reaches as high as 198F which far exceeds the 150F shown in the reset graphic. Recommend verifying HHW reset programming and HHW setpoint reference. Trending and an evaluation of the system has not revealed the cause of this issue. A controls contractor with knowledge of the control strategy in place is required to isolate the root cause of this issue. For that reason this measure is deleted from the PBEEEP findings workbook, but still needs to be addressed.		
Equipment or System(s):	Boiler Plant	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Contractor: Controls	Benefits:	Reduced steam use for generating heating hot water.
Baseline Documentation Method:	Trending of heating water loop temperature and the supply water temperature reset schedule		
Measure:	Repair function of heating hot water reset and supply water setpoint.		
Recommendation for Implementation:	Program the existing reset schedule to control the heating hot water supply temperature to the setpoint determined by the reset schedule.		
Evidence of Implementation Method:	Trending of heating hot water supply and return temperatures, supply temperature setpoint determined by the reset schedule and outside air temperature. Trending to occur during heating season for a duration of at least 3 weeks at an interval of 15 minutes or less.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Summary

Building: Delta Dormitory

Site: Perpich Center

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	AHU-DS1, DS2, DS3 are not fully integrated into the BAS.	$0	$0	0.00	$0	0.00	0
3	AHU- DS1 DS2 and DS3 supply 50% outside air at all times.	$0	$0	0.00	$0	0.00	0
4	AHU-DS3 T-Stat reading incorrect.	$0	$0	0.00	$0	0.00	0
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

Deleted Findings Details

Building: Delta Dormitory

FWB Number:	15302	Eco Number:	2
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	AHU-DS1, DS2, DS3 are not fully integrated into the BAS.	Date Identified:	1/9/2012
Description of Finding:	These AHUs are controlled by local controllers which are not integrated with the Automatrix BAS which controls the rest of the campus. Due to limited energy savings this measure is deleted from the PBEEEP findings workbook.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:		Benefits:	Reduced maintenance costs, improved occupant comfort, additional optimization opportunities.
Baseline Documentation Method:	Inspection of AHUs and controllers located in the Delta Boiler room.		
Measure:	Integrate DS1, DS2, and DS3 control into BAS		
Recommendation for Implementation:	Provide controllers, sensors, and programming to fully integrate AHUs DS1, DS2, and DS3 into the BAS. Minimum required points are DAT, MAT, MAT setpoint, RAT, Space Temp, Space Temp setpoint, space RH, space RH setpoint, OA/Economizer damper position, heating on/off cooling on/off.		
Evidence of Implementation Method:			

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

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Deleted Findings Details

Building: Delta Dormitory

FWB Number:	15302	Eco Number:	3
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	AHU- DS1 DS2 and DS3 supply 50% outside air at all times.	Date Identified:	1/9/2012
Description of Finding:	All three roof top AHUs at the Delta Dorm have two position OA and RA dampers and do not have full economizer function. The OA dampers simply open and close.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Controls contractor	Benefits:	Energy savings due to increased free cooling
Baseline Documentation Method:	Outside air percentage was calculated based on OAT, RAT and MAT recorded during trending.		
Measure:	Provide full economizer function on DS1, DS2, and DS3.		
Recommendation for Implementation:	Install new actuators on outside air dampers for AHUs DS1, DS2, and DS3. Provide economizer control on BAS based on return air and outside air conditions. Minimum OA damper position to be set to 28% (adj.). 28% is based on the existing building occupancy, the minimum required OA amount to be verified at time of economizer implementation.		
Evidence of Implementation Method:	Trending of return air temp, outside air temp, OA damper position, and fan status for a minimum of three weeks at an interval of 15 minutes or less.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details

Building: Delta Dormitory

FWB Number:	15302	Eco Number:	4
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	AHU-DS3 T-Stat reading incorrect.	Date Identified:	1/9/2012
Description of Finding:	Space temperature logged during heating season indicates thermostat location is not ideal. Recorded space temperatures were higher than recorded Return Air temperatures at each trend interval.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:		Benefits:	
Baseline Documentation Method:	Trending of space temperature and return air temperature during all seasons.		
Measure:			
Recommendation for Implementation:			
Evidence of Implementation Method:			

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Summary

Building: Gaia Building
Site: Perpich Center

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	AHU GS13 simultaneous heating and cooling.	$0	$0	0.00	$0	0.00	0
3	AHU GS13 Cooling setpoint is 70 F	$0	$0	0.00	$0	0.00	0
4	AHU GS13 Economizer operation not fully economizing.	$0	$0	0.00	$0	0.00	0
5	AHU GS13 heating setpoint is 71.	$0	$0	0.00	$0	0.00	0
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Gaia Building

FWB Number:	15303	Eco Number:	2
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	AHU GS13 simultaneous heating and cooling.	Date Identified:	10/24/2011
Description of Finding:	Trending indicates DX cooling is active when the steam heating valve opens. After further investigation this simultaneous heating and cooling situation is not using additional energy. At the times when simultaneous heating and cooling could occur there is not steam available, therefore the system is only cooling despite the steam valve being open also. It is still recommended that this issue be corrected to prevent any potential simultaneous heating and cooling that would occur if the steam system is active during the cooling season.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Controls contractor.	Benefits:	Potentially reduced electric and gas usage due to simultaneous heating and cooling.
Baseline Documentation Method:	Trending of AHU-GS13 shows times when the DX cooling is active and the steam heating valve opens.		
Measure:	Program steam heating valve to be disabled when the DX cooling is active.		
Recommendation for Implementation:	Controls contractor to program steam heating valve to remain closed when DX cooling is active.		
Evidence of Implementation Method:	Functional testing to verify correct valve function. Trending of DAT, Fan amps, DX status, and steam valve position. Trending duration to be a minimum of 2 weeks during the cooling season. The max trend interval allowed shall be 15 minutes.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details

PBEEEP State Government

Building: Gaia Building

FWB Number:	15303	Eco Number:	3
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	AHU GS13 Cooling setpoint is 70 F	Date Identified:	10/24/2011
Description of Finding:	Trending indicates the zone cooling setpoint for AHU GS13 is set to 70 F. This causes the condensing unit to operate during times when cooling is not needed and at times even over cool the space. DELETED. Trends of space temperature and return air temperature show temperatures ranging from 73-77F.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	In-house staff or contractor to change setpoint.	Benefits:	Reduced electrical usage due to less cooling required by the DX unit.
Baseline Documentation Method:	Trending of AHU-GS13 shows a cooling setpoint of 70 F at all times.		
Measure:	Change space temperature setpoint to 74 F.		
Recommendation for Implementation:	Adhere to state required space setpoint range of 74-76 F in cooling.		
Evidence of Implementation Method:	Trending of space temperature/setpoint and fan status. Trending to occur during the cooling season, duration to be at least 2 weeks, and the maximum trend interval shall be 15 minutes.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

PBEEEP State Government

Building: Gaia Building

FWB Number:	15303	Eco Number:	4
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	AHU GS13 Economizer operation not fully economizing.	Date Identified:	1/1/2012
Description of Finding:	Trending shows Economizer remains at 10% during all operating hours for summer trends. Economizer minimum changed to 20% in the shoulder months and the economizer functioned normally.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Controls contractor.	Benefits:	Reduced electrical usage due to reduced cooling load by the condensing unit.
Baseline Documentation Method:	Trending of AHU-GS13 shows the Economizer is not providing the Optimum MAT when possible.		
Measure:	Program economizer to operate based on outdoor and return air enthalpy readings. Utilize 10% minimum econ setting all year.		
Recommendation for Implementation:	Program outside air/economizer function to utilize outdoor and return air temperature and humidity sensors to calculate outdoor and return air enthalpies. Control economizer position based on the calculated enthalpies to maintain a mixed air temperature setpoint. FINDING DELETED DUE TO PAYBACK.		
Evidence of Implementation Method:	Trending of outdoor/return air temperature, mixed air temperature, humidity, enthalpy, and economizer position. Trending to occur during a shoulder season for a minimum duration of 2 weeks with a maximum trend interval of 15 minutes.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Gaia Building

FWB Number:	15303	Eco Number:	5
Site:	Perpich Center	Date/Time Created:	5/10/2012

Investigation Finding:	AHU GS13 heating setpoint is 71.	Date Identified:	1/1/2012
Description of Finding:	Heating season trends show a space temperature setpoint of 71 F. State required setpoints are 68-70. DELETED. Winter trending showed space temperatures ranging from 68-70F.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	In-house staff.	Benefits:	Reduced heating energy use.
Baseline Documentation Method:	Trending of AHU-GS14 during the heating season shows a space temperature setpoint of 71 F.		
Measure:	Change space temperature setpoint to be 70F or less.		
Recommendation for Implementation:	Adhere to state required space setpoint range of 68-70 F in heating.		
Evidence of Implementation Method:	Trending of space temperature/setpoint and fan status. Trending to occur during the heating season, duration to be at least 2 weeks, and the maximum trend interval shall be 15 minutes.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

SCREENING RESULTS FOR PERPICH CENTER FOR ARTS EDUCATION

Minnesota Department of Education

PCAE

February 28, 2011

Campus Overview

Perpich Center for Arts Education	
Location	6125 Olson Memorial Hwy Golden Valley, MN 55422
Facility Manager	Bill Nash Building Maintenance Foreman
Number of Buildings	4
Interior Square Footage	171,543
PBEEEP Provider	Center for Energy and Environment (Angela Vreeland)
Date Visited	January 25, 2011
Annual Energy Cost	$188,537 (from 2009 utility data)
Utility Company	Electric: Xcel Energy Natural Gas: CenterPoint Energy
Site Energy Use Index (EUI)	94 kBtu/sq ft* (from 2009 utility data)
Benchmark EUI (from B3)	108 kBtu/sq ft*

*NOTE: The Site and Benchmark EUIs do not include the Alpha Building, since that building is in the process of being demolished.

The Perpich Center for Arts Education serves nearly 300 11th and 12th graders approximately half of whom live on campus. It is comprised of four buildings totaling 171,543 square feet. The largest building on campus is the Administration Building, where the majority of offices and classrooms are located. The Administration Building has two wings, East and West. The East wing was built in 1965 and the West wing was added on in 1998. Delta Dormitory provides housing for 130 students. The Gaia Building has additional office space and classrooms. The Alpha Building is a warehouse that is in the process of being torn down. There is a map of each of the buildings at the end of this report.

Screening Overview

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities that will generate savings with a relatively short (1 to 5 years) and certain payback. The screening of the Perpich Center was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. A walk-through was conducted on January 25, 2011 and interviews with the facility staff were carried out to fully explore the status of the energy consuming equipment and their potential for recommissioning. This report is the result of that information.

Recommendation

A detailed investigation of the energy usage and energy savings opportunities of the three buildings listed below, with 157,575 square feet of interior space, is recommended at this time. The floor areas listed in the table have not been verified.

Building Name	State ID	Area (sq ft)	Year Built
Administration Building	E2500000627 E2500000727	105,610	1965
Delta Dormitory	E2500000427	36,855	1979
Gaia Building	E2500000327	15,110	1970

There are many factors that are part of the decision to recommend an energy investigation of a building; at the Perpich Center some of the characteristics that were taken into account during the building selection process include:

- Potential energy savings opportunities observed during screening phase
- Site Energy Use Intensity (EUI) compared to B3 Benchmark EUI
- Large square footage
- Level of control by the building automation system
- Equipment size and quantity
- Support from the staff and management to include building in an investigation

Below is the remaining building that is not recommended for investigation. The Alpha Building is not recommended for an investigation because it is in the process of being torn down.

Building Name	State ID	Area (sq ft)	Year Built
Alpha Building	E2500000127	13,968	1965

Recommended Buildings Descriptions

Details obtained through the screening process regarding the recommended buildings are included in the following:

Mechanical Equipment

The Administration Building has two low pressure steam boilers that provide 10 psi steam to the East Wing and the Gaia Building. A heat exchanger converts heat from the steam to hot water that is then circulated to the West Wing. Five air handlers serve the West Wing, two of which are variable volume and serve Variable Air Volume (VAV) boxes. Thirteen constant volume air handlers serve the East Wing. The East Wing also has perimeter steam radiation. Two chillers provide chilled water to fifteen of the air handlers during the spring, summer, and fall. One air handler has Direct eXpansion (DX) cooling and two air handlers do not have cooling.

The Delta Dormitory has three constant volume air handlers with DX cooling and hot water heat that serve the corridors and common areas. One boiler provides hot water to the air handlers and perimeter radiation. Another boiler provides domestic hot water for the bathrooms. There are approximately 50 exhaust fans, one for each bathroom.

The Gaia Building gets steam from the Administration Building. The steam is used in the air handlers and a heat exchanger converts heat from the steam to hot water for the perimeter radiation. Two air handlers with steam heat and DX cooling serve the Southern end of the building. The Northern end is heated by perimeter radiation and thirteen hot water Cabinet Unit Heaters (CUHs) and it is cooled by thirteen Fan Coil Units (FCUs).

The following table provides a summation of the equipment in the Administration Building, Delta Dormitory, and Gaia Building:

Mechanical Equipment Summary Table	
1	Building Automation System (Automatrix)
3	Buildings
157,575	Interior Square Feet
23	Air Handlers
52	VAV Boxes
~65	Exhaust Fans
22	Unit Heaters and Cabinet Unit Heaters
13	Fan Coil Units
2	Chillers
2	Hot Water Boilers
2	Steam Boilers
20	Pumps (HW, CHW, etc)
2	Heat Exchangers
954	Points Available for Trending
415	Minimum Points to be Trended per PBEEEP Guidelines
50	Data Loggers (22 temperature, 28 Motor status)

Controls and Trending

The equipment in the Administration Building and portions of Delta Dormitory and the Gaia Building are controlled by an Automatrix Building Automation System (BAS). The BAS is capable for trending and the trend data can be exported in a usable format for spreadsheet calculations. There is digital actuation and control throughout the Administration Building except for the perimeter radiation that serves the South side of the East Wing and the East Wing Library. The radiation in those areas is controlled by pneumatic thermostats. Some of the perimeter radiation on the North side of the East Wing is controlled by manual thermostats. The air handlers in the Delta Dormitory are controlled by the BAS, but the boilers, exhaust fans, and cabinet unit heaters are not; they have stand-alone or manual control. Both air handlers in the Gaia Building are controlled by the BAS. The fan coil units and cabinet unit heaters are on local control and the hot water valves in the Gaia Building are controlled pneumatically.

Lighting

The majority of interior lighting on campus is 32 watt T8s. There are occupancy sensors in Delta Dormitory and in the restrooms of the East Wing of the Administration Building. The West Wing corridors of the Administration Building are controlled by the BAS. The remaining lights throughout the buildings are controlled by manual switches.

Energy Use Index and B3 Benchmark

The Administration Building provides steam to the Gaia Building, so the energy use of the two buildings cannot be separated. The site Energy Use Index (EUI) for both buildings is 94 kBtu/sqft, which is 7% lower than their B3 Benchmark of 101 kBtu/sqft. The Delta Dormitory has an EUI of 95 kBtu/sqft, which is 27% lower than its B3 Benchmark of 130 kBtu/sqft.

The median site EUI for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks. This indicates that the Perpich Center has the potential to further reduce its energy use.

Metering

The Administration Building has one electric and one natural gas meter. Delta Dormitory also has one of each meter type and the Gaia Building has one electric meter only, because it gets steam from the Administration Building.

Documentation

There is some mechanical documentation, including building plans, equipment schedules, operations and maintenance manuals, balance reports, and control sequences available on-site.

Building Summary Tables

The following tables are based on information gathered from interviews with facility staff, building walk-throughs, automation system screen-captures, and equipment documentation. The purpose of these tables is to provide the size and quantity of equipment and the level of control present in each building. It is complete and accurate to the best of our knowledge. The buildings below are those being recommended for investigation.

Administration Building **State ID# E2500000727/ E2500000627**					
Area (sqft)	105,610	Year Built	1965	Occupancy (hrs/yr)	2,808
HVAC Equipment					

Air Handlers (18 Total)

Description	**Type**	**Size**	**Notes**
AHU 1	Constant Volume	1.5 hp SF	HW, serves Boiler Rm in West Wing.
AHU 2	VAV with VFDs	18,800 cfm 20 hp SF 15 hp RF	HW and CHW, serves 29 VAV boxes in the West Wing.
AHU 3	VAV with VFDs	14,000 cfm 15 hp SF 10 hp RF	HW and CHW, serves 23 VAV boxes in the West Wing.
AHU 4	VAV with VFDs	6,000 cfm 7.5 hp SF 5 hp RF	HW and CHW, serves West Wing.
ERU	VAV with VFDs	14,168 cfm 15 hp SF 15 hp EF	Air handler that contains a heat recovery wheel, serves West Wing.
S 1	Constant Volume	10,450 cfm 15 hp SF	Steam and CHW, serves Dance Studio in East Wing.
S 2	Constant Volume	8,350 cfm 10 hp SF	Steam and CHW, serves Theater in East Wing.
S 3	Constant Volume	6,700 cfm 10 hp SF	Steam and CHW, serves South Classrooms in East Wing.
S 4	Constant Volume	5,320 cfm 7.5 hp SF	Steam and CHW, serves Library in East Wing.
S 5	Constant Volume	3,500 cfm 5 hp SF	Steam and CHW, serves Stage in East Wing.
S 6	Constant Volume	8,350 cfm 10 hp SF	Steam and CHW, serves Student Services in East Wing.
S 7	Constant Volume	5,640 cfm 10 hp SF	Steam and CHW, serves North Offices in East Wing.
S 8	Constant Volume	5,640 cfm 10 hp SF	Steam and CHW, serves Upper Lounge in East Wing.
S 9	Constant Volume	5,500 cfm 7.5 hp SF	Steam and CHW, serves Lower Lounge in East Wing.
S 10	Constant Volume	5,000 cfm 7.5 hp SF	Steam and CHW, serves Administration Offices in East Wing.
S 11	Constant Volume	5,00 cfm 7.5 hp SF	Steam and CHW, serves Dining Room in East Wing.

HVAC Equipment Cont'd- Administration Building

Air Handlers (18 Total)

Description	Type	Size	Notes
S 12	Constant Volume	800 cfm 1.5 hp SF	Steam and CHW, serves Classroom 124 in East Wing.
Computer Server AHU	Constant Volume	2,000 cfm 0.75 hp	Electric heat and 2-stage DX cooling, serves Computer/Server Room in East Wing.

VAV Boxes (52 Total)

Description	Type	Size	Notes
VAV Boxes		135-1,575 cfm each	HW reheat, served by AHUs 2 and 3 in the West Wing.

Heating System

Description	Type	Size	Notes
Boiler 1 Boiler 2	Low Pressure Steam Boilers	6,695 kBtu/hr output each 8,369 kBtu/hr input each	Supplies 10 psi steam to East Wing and to the Gaia Building, a heat exchanger produces HW for use in West Wing. Operated from October to end of May.
1 HX	Steam to HW Converter		Produces HW for use in West Wing AHUs and reheats. HW supply temperature resets based on OAT.
P-1 P-2	Constant Volume HW Pumps	5 hp each	
3 Make-up Water Pumps	Constant Volume Pumps	0.75 hp each	
5 Condensate Pumps	Constant Volume Pumps	3 hp each	
FTR	Finned-Tube Radiation		Steam, serves East Wing

Cooling System

Description	Type	Size	Notes
Chiller 1	Air-Cooled Screw Chiller	100 Tons	Runs lead-lag with Chiller 2. CHW supply temperature is reset between 115 and 135 F, depending on OAT.
Chiller 2	Air-Cooled Scroll Chiller	120 Tons	
P-3 P-4	Constant Volume CHW Pumps	5 hp each	Primary loop pumps, P-3 serves Chiller 1, P-4 serves Chiller 2.
P-5	Variable Volume CHW Pump	20 hp	VFD, serves secondary loop.

Cabinet Unit Heaters (7 Total)

Description	Type	Size	Notes
7 CUHs	4 HW and 3 steam Cabinet Unit Heaters		4 HW CUHs serve the West Wing, 3 steam CUHs serve the East Wing.

Exhaust Fans (15 Total)

Description	Type	Size	Notes
15 EFs		Unknown	

Points on BAS- Administration Building

Air Handlers

Description	Points
AHU 1	OAT, OARH, Heating valve, SF status, DAT, Space temp, Space setpoint
AHU 2 AHU 3 AHU 4	RA enth, RA CO2, RARH, RAT, RF status, RF VFD speed, OAT, OARH, OA enth, Econ damper position, OA cfm, MAT, Heating valve, Cooling valve, SF status, SF VFD speed, DAT, DA DSP, Space static pressure, Occ/Unocc, Space static setpoint, DA DSP setpoint, Heating setpoint, Cooling setpoint, MAT setpoint
ERU	DAT, SF VFD speed, OAT, Heat wheel speed, RARH, RAT, EF VFD speed, EAT, DAT setpoint, Sum/wint switchover setpoint
S 1 – S 5 S 8 – S 9 S 11 – S 12	RARH, Econ damper position, MAT, Heating valve, Cooling valve 1, Cooling valve 2, SF Amps, DAT, Space temp, Heating setpoint, Cooling setpoint, Econ setpoint, Min econ damper position
S 6 S 7 S 10	RARH, Econ damper position, MAT, Heating valve, Cooling valve, SF status, DAT, Space temp, Min OA damper position, Max OA damper position, Max reset temp value, MAT setpoint, Heating setpoint, Cooling setpoint
Computer Server AHU	Econ cooling stage 1, RAT, MAT, Heating stage 1, Heating stage 2, DX stage 1, SF status, DAT, Space temp, Heating setpoint, Cooling setpoint

VAV Boxes

Description	Points
Each Unit	Actual airflow (cfm), Calculated airflow, Cooling setpoint, Heating setpoint, Calculated cooling setpoint, Calculated heating setpoint, Heating valve, Zone temp, Thermostat setpoint, Thermostat multiplier

Heating System

Description	Points
Boilers	Boiler 1 enable, Boiler 2 enable, Steam header pressure, HWST, HWRT, HW diff pressure, Pump 1 status, Pump 2 status, DHWST, DHW pump 4 status, Boiler room space temp, Fuel oil pump 1 status, Fuel oil pump 2 status
HX	Steam pressure, 1/3 steam valve, 2/3 steam valve, HWST, P-1 command, P-2 command, HWRT, HWST reset settings, OAT enable setpoint
FTR	Space temp, Setpoint, Deadband, Valve position

Cooling System

Description	Points
Chiller 1	P-3 command, CHWRT, CHWST, OAT, OAT chiller enable setpoint, Chiller status, Pump 5 status, Pump 5 speed, CHWST reset settings
Chiller 2	P-4 command, CHWRT, CHWST, OAT, OAT chiller enable setpoint, Chiller status, CHWST reset setttings

Cabinet Unit Heaters

Description	Points
West Wing Units	Space temp, Unit status, Space setpoint
East Wing Units	***Not on the BAS; there are no points available for trending.***

Exhaust Fans

Description	Points
Each Unit	EF status, EF Amp draw (not all units)

Delta Dormitory State ID# E2500000427					
Area (sqft)	36,855	Year Built	1979	Occupancy (hrs/yr)	5,460

HVAC Equipment

Air Handlers (3 Total)

Description	Type	Size	Notes
S-1	Constant Volume	3 hp SF	HW and DX (12.5 ton condenser), serve hallways and common areas.
S-2	Constant Volume	1.5 hp SF	HW and DX (7.5 ton condenser), serve hallways and common areas.
S-3	Constant Volume	3 hp SF	HW and DX (12.5 ton condenser), serve hallways and common areas.

Heating System

Description	Type	Size	Notes
Boiler	HW Boiler	Unknown	Supplies HW to air handlers and radiation.
Boiler	HW Boiler	Unknown	Supplies domestic HW for baths.
2 HWPs	HW Pumps	3 hp each	
FTR	Finned-Tube Radiation		HW

Exhaust Fans (~50 Total)

Description	Type	Size	Notes
~50 EFs	Exhaust Fans	< 1 hp each	Serve baths

Cabinet Unit Heaters (2 Total)

Description	Type	Size	Notes
2 CUHs	Cabinet Unit Heaters	Unknown	Serve Rec Room

Points on BAS

Air Handlers

Description	Points
S-1 S-2 S-3	OAT, RAT, SF status, DAT, Space temp, Occ/Unocc

Heating System

Description	Points
System	***Not on the BAS; there are no points available for trending.***

Exhaust Fans

Description	Points
Each Unit	***Not on the BAS; there are no points available for trending.***

Cabinet Unit Heaters

Description	Points
Each Unit	***Not on the BAS; there are no points available for trending.***

Gaia Building State ID# E2500000327					
Area (sqft)	36,855	Year Built	1979	Occupancy (hrs/yr)	2,530

HVAC Equipment

Air Handlers (2 Total)

Description	Type	Size	Notes
S-13	Constant Volume	Unknown	Steam and DX, serves lower level of South end.
S-14	Constant Volume	3 hp SF	Steam and DX, Face/Bypass, serves conference room on South end.

Heating System

Description	Type	Size	Notes
1 Steam to HW HX	Steam to HW Converter		Provides HW to perimeter radiation
2 Condensate Pumps	Pumps	¾ hp each	
3 HWPs	HW Pumps	< 1 hp each	
FTR	Finned-Tube Radiation		HW

Fan Coil Units (13 Total)

Description	Type	Size	Notes
13 FCUs	Fan Coil Unit	800-1,200 cfm, 2-3 tons each	Each serves a room on the North end.

Cabinet Unit Heaters (13 Total)

Description	Type	Size	Notes
13 CUHs	Cabinet Unit Heaters	750-1,250 cfm, < 1 hp each	HW, each serves a room on the North end.

Points on BAS

Air Handlers

Description	Points
S-13	Economizer damper position, RAT, MAT, Steam valve, DX cooling, Fan amps, Fan status, DAT, Space temp, Heating setpoint, Cooling setpoint, OAT cooling lockout, Economizer setpoint, OAT econ lockout, Min damper position.
S-14	OAT, Economizer damper position, RAT, MAT, F/BP damper position, Steam valve, DX cooling, Fan amps, Fan status, DAT, Space temp, Heating zone temp setpoint, F/BP zone temp setpoint, F/BP OAT switchover setpoint, Steam valve position when F/BP damper enabled, Cooling setpoint, OAT cooling lockout, Economizer setpoint, OAT econ lockout, Min damper position

Heating System

Description	Points
System	***Not on the BAS; there are no points available for trending.***

Fan Coil Units

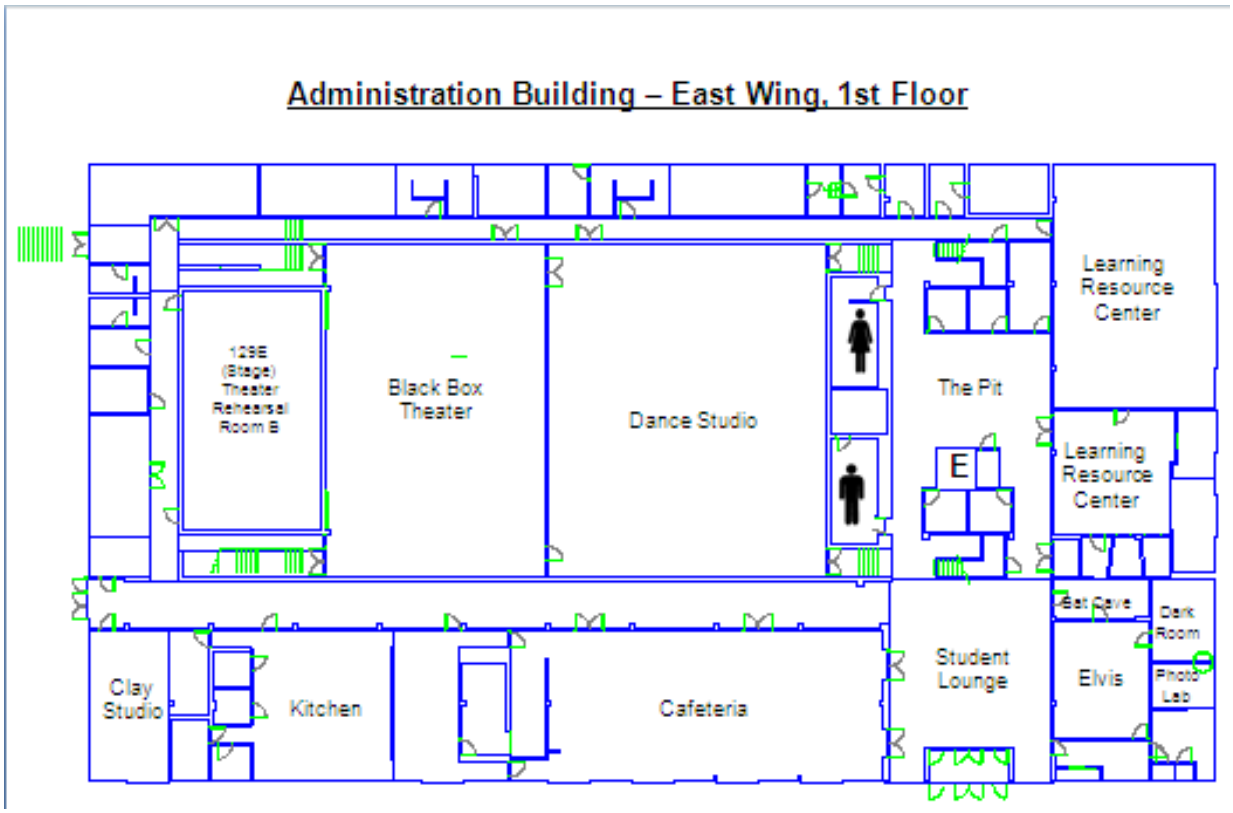
Description	Points
Each Unit	***Not on the BAS; there are no points available for trending.***

Cabinet Unit Heaters

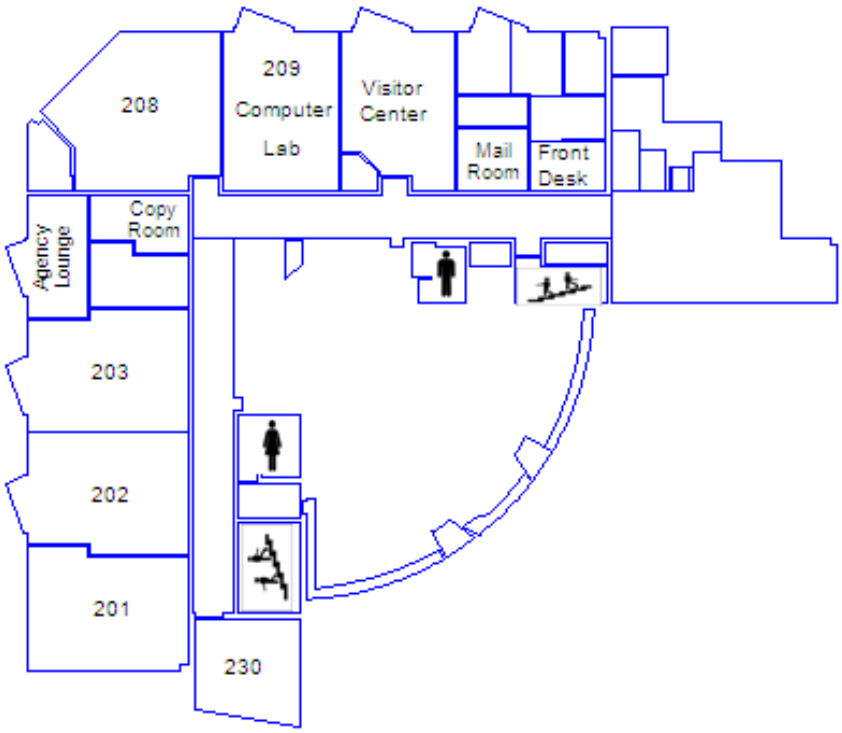
Description	Points
Each Unit	***Not on the BAS; there are no points available for trending.***

Building Floor Plans

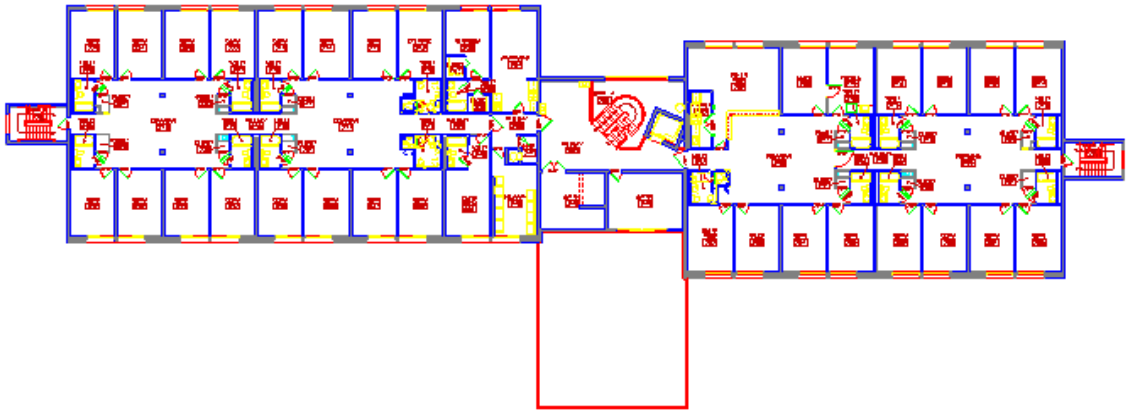
Administration Building – East Wing, 1st Floor

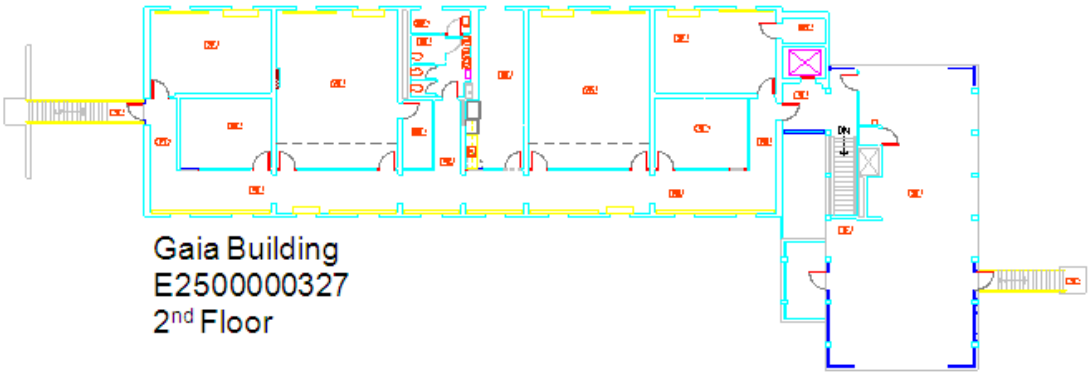


Administration Building – West Wing, 2nd Floor



Delta Dormitory
E2500000427
2nd Floor





Gaia Building
E2500000327
2nd Floor

PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HP	Horsepower
BAS	Building Automation System	HRU	Heat Recovery Unit
CD	Cold Deck	HW	Hot Water
CDW	Condenser Water	HWDP	Hot Water Differential Pressure
CDWRT	Condenser Water Return Temperature	HWP	Hot Water Pump
CDWST	Condenser Water Supply Temperature	HWRT	Hot Water Return Temperature
CFM	Cubic Feet per Minute	HWST	Hot Water Supply Temperature
CHW	Chilled Water	HX	Heat Exchanger
CHWRT	Chilled Water Return Temperature	kW	Kilowatt
CHWDP	Chilled Water Differential Pressure	kWh	Kilowatt-hour
CHWP	Chilled Water Pump	MA	Mixed Air
CHWST	Chilled Water Supply Temperature	MA Enth	Mixed Air Enthalpy
CRAC	Computer Room Air Conditioner	MARH	Mixed Air Relative Humidity
CV	Constant Volume	MAT	Mixed Air Temperature
DA	Discharge Air	MAU	Make-up Air Unit
DA Enth	Discharge Air Enthalpy	OA	Outside Air
DARH	Discharge Air Relative Humidity	OA Enth	Outside Air Enthalpy
DAT	Discharge Air Temperature	OARH	Outside Air Relative Humidity
DDC	Direct Digital Control	OAT	Outside Air Temperature
DP	Differential Pressure	Occ	Occupied
DSP	Duct Static Pressure	PTAC	Packaged Terminal Air Conditioner
DX	Direct Expansion	RA	Return Air
EA	Exhaust Air	RA Enth	Return Air Enthalpy
EAT	Exhaust Air Temperature	RARH	Return Air Relative Humidity
Econ	Economizer	RAT	Return Air Temperature
EF	Exhaust Fan	RF	Return Fan
Enth	Enthalpy	RH	Relative Humidity
ERU	Energy Recovery Unit	RTU	Rooftop Unit
FCU	Fan Coil Unit	SF	Supply Fan
FPVAV	Fan Powered VAV	Unocc	Unoccupied
FTR	Fin Tube Radiation	VAV	Variable Air Volume
GPM	Gallons per Minute	VFD	Variable Frequency Drive
HD	Hot Deck	VIGV	Variable Inlet Guide Vanes

Conversions
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH

PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

SCREENING RESULTS FOR PERPICH CENTER FOR ARTS EDUCATION

Minnesota Department of Education

PCAE

February 28, 2011

Campus Overview

Perpich Center for Arts Education	
Location	6125 Olson Memorial Hwy Golden Valley, MN 55422
Facility Manager	Bill Nash Building Maintenance Foreman
Number of Buildings	4
Interior Square Footage	171,543
PBEEEP Provider	Center for Energy and Environment (Angela Vreeland)
Date Visited	January 25, 2011
Annual Energy Cost	$188,537 (from 2009 utility data)
Utility Company	Electric: Xcel Energy Natural Gas: CenterPoint Energy
Site Energy Use Index (EUI)	94 kBtu/sq ft* (from 2009 utility data)
Benchmark EUI (from B3)	108 kBtu/sq ft*

*NOTE: The Site and Benchmark EUIs do not include the Alpha Building, since that building is in the process of being demolished.

The Perpich Center for Arts Education serves nearly 300 11th and 12th graders approximately half of whom live on campus. It is comprised of four buildings totaling 171,543 square feet. The largest building on campus is the Administration Building, where the majority of offices and classrooms are located. The Administration Building has two wings, East and West. The East wing was built in 1965 and the West wing was added on in 1998. Delta Dormitory provides housing for 130 students. The Gaia Building has additional office space and classrooms. The Alpha Building is a warehouse that is in the process of being torn down. There is a map of each of the buildings at the end of this report.

Screening Overview

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities that will generate savings with a relatively short (1 to 5 years) and certain payback. The screening of the Perpich Center was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. A walk-through was conducted on January 25, 2011 and interviews with the facility staff were carried out to fully explore the status of the energy consuming equipment and their potential for recommissioning. This report is the result of that information.

Recommendation

A detailed investigation of the energy usage and energy savings opportunities of the three buildings listed below, with 157,575 square feet of interior space, is recommended at this time. The floor areas listed in the table have not been verified.

Building Name	State ID	Area (sq ft)	Year Built
Administration Building	E2500000627 E2500000727	105,610	1965
Delta Dormitory	E2500000427	36,855	1979
Gaia Building	E2500000327	15,110	1970

There are many factors that are part of the decision to recommend an energy investigation of a building; at the Perpich Center some of the characteristics that were taken into account during the building selection process include:

- Potential energy savings opportunities observed during screening phase
- Site Energy Use Intensity (EUI) compared to B3 Benchmark EUI
- Large square footage
- Level of control by the building automation system
- Equipment size and quantity
- Support from the staff and management to include building in an investigation

Below is the remaining building that is not recommended for investigation. The Alpha Building is not recommended for an investigation because it is in the process of being torn down.

Building Name	State ID	Area (sq ft)	Year Built
Alpha Building	E2500000127	13,968	1965

Recommended Buildings Descriptions

Details obtained through the screening process regarding the recommended buildings are included in the following:

Mechanical Equipment

The Administration Building has two low pressure steam boilers that provide 10 psi steam to the East Wing and the Gaia Building. A heat exchanger converts heat from the steam to hot water that is then circulated to the West Wing. Five air handlers serve the West Wing, two of which are variable volume and serve Variable Air Volume (VAV) boxes. Thirteen constant volume air handlers serve the East Wing. The East Wing also has perimeter steam radiation. Two chillers provide chilled water to fifteen of the air handlers during the spring, summer, and fall. One air handler has Direct eXpansion (DX) cooling and two air handlers do not have cooling.

The Delta Dormitory has three constant volume air handlers with DX cooling and hot water heat that serve the corridors and common areas. One boiler provides hot water to the air handlers and perimeter radiation. Another boiler provides domestic hot water for the bathrooms. There are approximately 50 exhaust fans, one for each bathroom.

The Gaia Building gets steam from the Administration Building. The steam is used in the air handlers and a heat exchanger converts heat from the steam to hot water for the perimeter radiation. Two air handlers with steam heat and DX cooling serve the Southern end of the building. The Northern end is heated by perimeter radiation and thirteen hot water Cabinet Unit Heaters (CUHs) and it is cooled by thirteen Fan Coil Units (FCUs).

The following table provides a summation of the equipment in the Administration Building, Delta Dormitory, and Gaia Building:

Mechanical Equipment Summary Table	
1	Building Automation System (Automatrix)
3	Buildings
157,575	Interior Square Feet
23	Air Handlers
52	VAV Boxes
~65	Exhaust Fans
22	Unit Heaters and Cabinet Unit Heaters
13	Fan Coil Units
2	Chillers
2	Hot Water Boilers
2	Steam Boilers
20	Pumps (HW, CHW, etc)
2	Heat Exchangers
954	Points Available for Trending
415	Minimum Points to be Trended per PBEEEP Guidelines
50	Data Loggers (22 temperature, 28 Motor status)

Controls and Trending

The equipment in the Administration Building and portions of Delta Dormitory and the Gaia Building are controlled by an Automatrix Building Automation System (BAS). The BAS is capable for trending and the trend data can be exported in a usable format for spreadsheet calculations. There is digital actuation and control throughout the Administration Building except for the perimeter radiation that serves the South side of the East Wing and the East Wing Library. The radiation in those areas is controlled by pneumatic thermostats. Some of the perimeter radiation on the North side of the East Wing is controlled by manual thermostats. The air handlers in the Delta Dormitory are controlled by the BAS, but the boilers, exhaust fans, and cabinet unit heaters are not; they have stand-alone or manual control. Both air handlers in the Gaia Building are controlled by the BAS. The fan coil units and cabinet unit heaters are on local control and the hot water valves in the Gaia Building are controlled pneumatically.

Lighting

The majority of interior lighting on campus is 32 watt T8s. There are occupancy sensors in Delta Dormitory and in the restrooms of the East Wing of the Administration Building. The West Wing corridors of the Administration Building are controlled by the BAS. The remaining lights throughout the buildings are controlled by manual switches.

Energy Use Index and B3 Benchmark

The Administration Building provides steam to the Gaia Building, so the energy use of the two buildings cannot be separated. The site Energy Use Index (EUI) for both buildings is 94 kBtu/sqft, which is 7% lower than their B3 Benchmark of 101 kBtu/sqft. The Delta Dormitory has an EUI of 95 kBtu/sqft, which is 27% lower than its B3 Benchmark of 130 kBtu/sqft.

The median site EUI for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks. This indicates that the Perpich Center has the potential to further reduce its energy use.

Metering

The Administration Building has one electric and one natural gas meter. Delta Dormitory also has one of each meter type and the Gaia Building has one electric meter only, because it gets steam from the Administration Building.

Documentation

There is some mechanical documentation, including building plans, equipment schedules, operations and maintenance manuals, balance reports, and control sequences available on-site.

Building Summary Tables

The following tables are based on information gathered from interviews with facility staff, building walk-throughs, automation system screen-captures, and equipment documentation. The purpose of these tables is to provide the size and quantity of equipment and the level of control present in each building. It is complete and accurate to the best of our knowledge. The buildings below are those being recommended for investigation.

Administration Building **State ID# E2500000727/ E2500000627**					
Area (sqft)	105,610	Year Built	1965	Occupancy (hrs/yr)	2,808
HVAC Equipment					

Air Handlers (18 Total)

Description	**Type**	**Size**	**Notes**
AHU 1	Constant Volume	1.5 hp SF	HW, serves Boiler Rm in West Wing.
AHU 2	VAV with VFDs	18,800 cfm 20 hp SF 15 hp RF	HW and CHW, serves 29 VAV boxes in the West Wing.
AHU 3	VAV with VFDs	14,000 cfm 15 hp SF 10 hp RF	HW and CHW, serves 23 VAV boxes in the West Wing.
AHU 4	VAV with VFDs	6,000 cfm 7.5 hp SF 5 hp RF	HW and CHW, serves West Wing.
ERU	VAV with VFDs	14,168 cfm 15 hp SF 15 hp EF	Air handler that contains a heat recovery wheel, serves West Wing.
S 1	Constant Volume	10,450 cfm 15 hp SF	Steam and CHW, serves Dance Studio in East Wing.
S 2	Constant Volume	8,350 cfm 10 hp SF	Steam and CHW, serves Theater in East Wing.
S 3	Constant Volume	6,700 cfm 10 hp SF	Steam and CHW, serves South Classrooms in East Wing.
S 4	Constant Volume	5,320 cfm 7.5 hp SF	Steam and CHW, serves Library in East Wing.
S 5	Constant Volume	3,500 cfm 5 hp SF	Steam and CHW, serves Stage in East Wing.
S 6	Constant Volume	8,350 cfm 10 hp SF	Steam and CHW, serves Student Services in East Wing.
S 7	Constant Volume	5,640 cfm 10 hp SF	Steam and CHW, serves North Offices in East Wing.
S 8	Constant Volume	5,640 cfm 10 hp SF	Steam and CHW, serves Upper Lounge in East Wing.
S 9	Constant Volume	5,500 cfm 7.5 hp SF	Steam and CHW, serves Lower Lounge in East Wing.
S 10	Constant Volume	5,000 cfm 7.5 hp SF	Steam and CHW, serves Administration Offices in East Wing.
S 11	Constant Volume	5,00 cfm 7.5 hp SF	Steam and CHW, serves Dining Room in East Wing.

HVAC Equipment Cont'd- Administration Building

Air Handlers (18 Total)

Description	Type	Size	Notes
S 12	Constant Volume	800 cfm 1.5 hp SF	Steam and CHW, serves Classroom 124 in East Wing.
Computer Server AHU	Constant Volume	2,000 cfm 0.75 hp	Electric heat and 2-stage DX cooling, serves Computer/Server Room in East Wing.

VAV Boxes (52 Total)

Description	Type	Size	Notes
VAV Boxes		135-1,575 cfm each	HW reheat, served by AHUs 2 and 3 in the West Wing.

Heating System

Description	Type	Size	Notes
Boiler 1 Boiler 2	Low Pressure Steam Boilers	6,695 kBtu/hr output each 8,369 kBtu/hr input each	Supplies 10 psi steam to East Wing and to the Gaia Building, a heat exchanger produces HW for use in West Wing. Operated from October to end of May.
1 HX	Steam to HW Converter		Produces HW for use in West Wing AHUs and reheats. HW supply temperature resets based on OAT.
P-1 P-2	Constant Volume HW Pumps	5 hp each	
3 Make-up Water Pumps	Constant Volume Pumps	0.75 hp each	
5 Condensate Pumps	Constant Volume Pumps	3 hp each	
FTR	Finned-Tube Radiation		Steam, serves East Wing

Cooling System

Description	Type	Size	Notes
Chiller 1	Air-Cooled Screw Chiller	100 Tons	Runs lead-lag with Chiller 2. CHW supply temperature is reset between 115 and 135 F, depending on OAT.
Chiller 2	Air-Cooled Scroll Chiller	120 Tons	
P-3 P-4	Constant Volume CHW Pumps	5 hp each	Primary loop pumps, P-3 serves Chiller 1, P-4 serves Chiller 2.
P-5	Variable Volume CHW Pump	20 hp	VFD, serves secondary loop.

Cabinet Unit Heaters (7 Total)

Description	Type	Size	Notes
7 CUHs	4 HW and 3 steam Cabinet Unit Heaters		4 HW CUHs serve the West Wing, 3 steam CUHs serve the East Wing.

Exhaust Fans (15 Total)

Description	Type	Size	Notes
15 EFs		Unknown	

Points on BAS- Administration Building

Air Handlers

Description	Points
AHU 1	OAT, OARH, Heating valve, SF status, DAT, Space temp, Space setpoint
AHU 2 AHU 3 AHU 4	RA enth, RA CO2, RARH, RAT, RF status, RF VFD speed, OAT, OARH, OA enth, Econ damper position, OA cfm, MAT, Heating valve, Cooling valve, SF status, SF VFD speed, DAT, DA DSP, Space static pressure, Occ/Unocc, Space static setpoint, DA DSP setpoint, Heating setpoint, Cooling setpoint, MAT setpoint
ERU	DAT, SF VFD speed, OAT, Heat wheel speed, RARH, RAT, EF VFD speed, EAT, DAT setpoint, Sum/wint switchover setpoint
S 1 – S 5 S 8 – S 9 S 11 – S 12	RARH, Econ damper position, MAT, Heating valve, Cooling valve 1, Cooling valve 2, SF Amps, DAT, Space temp, Heating setpoint, Cooling setpoint, Econ setpoint, Min econ damper position
S 6 S 7 S 10	RARH, Econ damper position, MAT, Heating valve, Cooling valve, SF status, DAT, Space temp, Min OA damper position, Max OA damper position, Max reset temp value, MAT setpoint, Heating setpoint, Cooling setpoint
Computer Server AHU	Econ cooling stage 1, RAT, MAT, Heating stage 1, Heating stage 2, DX stage 1, SF status, DAT, Space temp, Heating setpoint, Cooling setpoint

VAV Boxes

Description	Points
Each Unit	Actual airflow (cfm), Calculated airflow, Cooling setpoint, Heating setpoint, Calculated cooling setpoint, Calculated heating setpoint, Heating valve, Zone temp, Thermostat setpoint, Thermostat multiplier

Heating System

Description	Points
Boilers	Boiler 1 enable, Boiler 2 enable, Steam header pressure, HWST, HWRT, HW diff pressure, Pump 1 status, Pump 2 status, DHWST, DHW pump 4 status, Boiler room space temp, Fuel oil pump 1 status, Fuel oil pump 2 status
HX	Steam pressure, 1/3 steam valve, 2/3 steam valve, HWST, P-1 command, P-2 command, HWRT, HWST reset settings, OAT enable setpoint
FTR	Space temp, Setpoint, Deadband, Valve position

Cooling System

Description	Points
Chiller 1	P-3 command, CHWRT, CHWST, OAT, OAT chiller enable setpoint, Chiller status, Pump 5 status, Pump 5 speed, CHWST reset settings
Chiller 2	P-4 command, CHWRT, CHWST, OAT, OAT chiller enable setpoint, Chiller status, CHWST reset setttings

Cabinet Unit Heaters

Description	Points
West Wing Units	Space temp, Unit status, Space setpoint
East Wing Units	***Not on the BAS; there are no points available for trending.***

Exhaust Fans

Description	Points
Each Unit	EF status, EF Amp draw (not all units)

Delta Dormitory State ID# E2500000427					
Area (sqft)	36,855	Year Built	1979	Occupancy (hrs/yr)	5,460

HVAC Equipment

Air Handlers (3 Total)

Description	Type	Size	Notes
S-1	Constant Volume	3 hp SF	HW and DX (12.5 ton condenser), serve hallways and common areas.
S-2	Constant Volume	1.5 hp SF	HW and DX (7.5 ton condenser), serve hallways and common areas.
S-3	Constant Volume	3 hp SF	HW and DX (12.5 ton condenser), serve hallways and common areas.

Heating System

Description	Type	Size	Notes
Boiler	HW Boiler	Unknown	Supplies HW to air handlers and radiation.
Boiler	HW Boiler	Unknown	Supplies domestic HW for baths.
2 HWPs	HW Pumps	3 hp each	
FTR	Finned-Tube Radiation		HW

Exhaust Fans (~50 Total)

Description	Type	Size	Notes
~50 EFs	Exhaust Fans	< 1 hp each	Serve baths

Cabinet Unit Heaters (2 Total)

Description	Type	Size	Notes
2 CUHs	Cabinet Unit Heaters	Unknown	Serve Rec Room

Points on BAS

Air Handlers

Description	Points
S-1 S-2 S-3	OAT, RAT, SF status, DAT, Space temp, Occ/Unocc

Heating System

Description	Points
System	***Not on the BAS; there are no points available for trending.***

Exhaust Fans

Description	Points
Each Unit	***Not on the BAS; there are no points available for trending.***

Cabinet Unit Heaters

Description	Points
Each Unit	***Not on the BAS; there are no points available for trending.***

Gaia Building State ID# E2500000327					
Area (sqft)	36,855	Year Built	1979	Occupancy (hrs/yr)	2,530

HVAC Equipment

Air Handlers (2 Total)

Description	Type	Size	Notes
S-13	Constant Volume	Unknown	Steam and DX, serves lower level of South end.
S-14	Constant Volume	3 hp SF	Steam and DX, Face/Bypass, serves conference room on South end.

Heating System

Description	Type	Size	Notes
1 Steam to HW HX	Steam to HW Converter		Provides HW to perimeter radiation
2 Condensate Pumps	Pumps	¾ hp each	
3 HWPs	HW Pumps	< 1 hp each	
FTR	Finned-Tube Radiation		HW

Fan Coil Units (13 Total)

Description	Type	Size	Notes
13 FCUs	Fan Coil Unit	800-1,200 cfm, 2-3 tons each	Each serves a room on the North end.

Cabinet Unit Heaters (13 Total)

Description	Type	Size	Notes
13 CUHs	Cabinet Unit Heaters	750-1,250 cfm, < 1 hp each	HW, each serves a room on the North end.

Points on BAS

Air Handlers

Description	Points
S-13	Economizer damper position, RAT, MAT, Steam valve, DX cooling, Fan amps, Fan status, DAT, Space temp, Heating setpoint, Cooling setpoint, OAT cooling lockout, Economizer setpoint, OAT econ lockout, Min damper position.
S-14	OAT, Economizer damper position, RAT, MAT, F/BP damper position, Steam valve, DX cooling, Fan amps, Fan status, DAT, Space temp, Heating zone temp setpoint, F/BP zone temp setpoint, F/BP OAT switchover setpoint, Steam valve position when F/BP damper enabled, Cooling setpoint, OAT cooling lockout, Economizer setpoint, OAT econ lockout, Min damper position

Heating System

Description	Points
System	***Not on the BAS; there are no points available for trending.***

Fan Coil Units

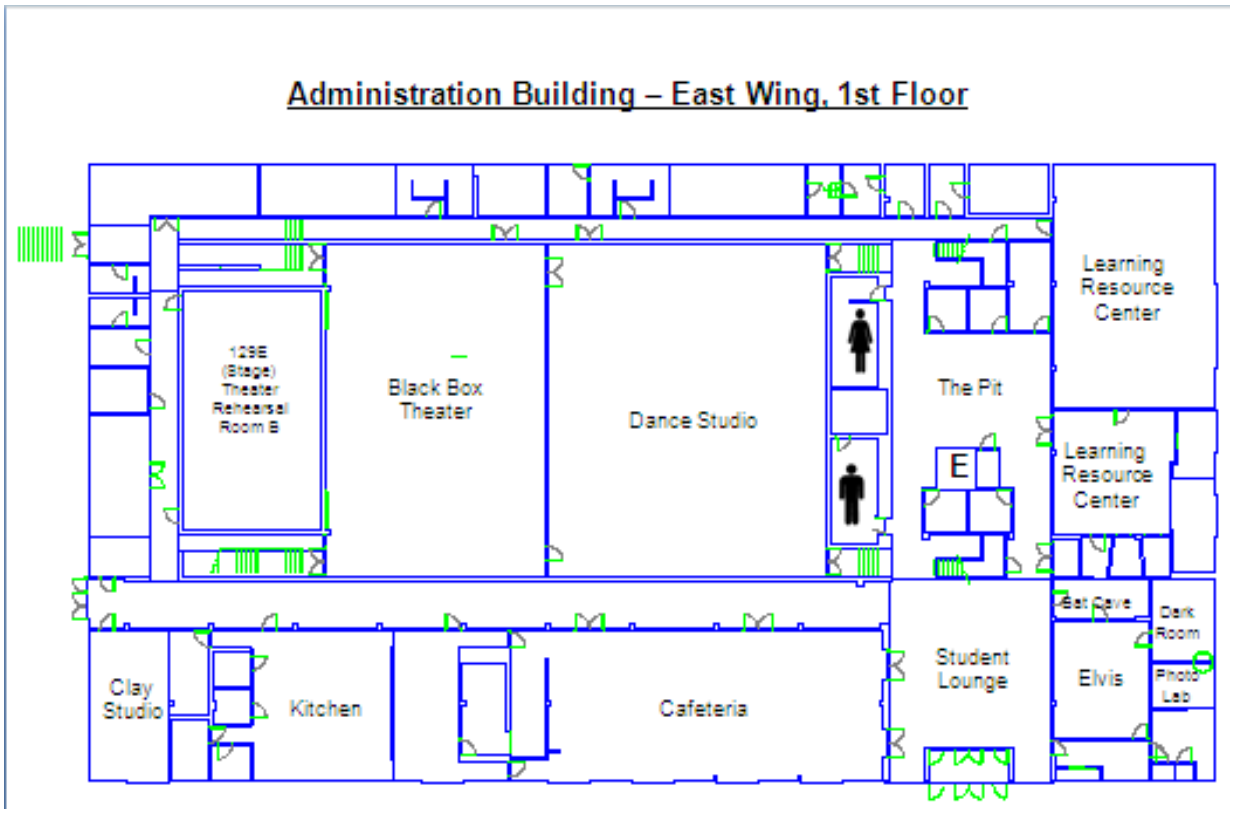
Description	Points
Each Unit	***Not on the BAS; there are no points available for trending.***

Cabinet Unit Heaters

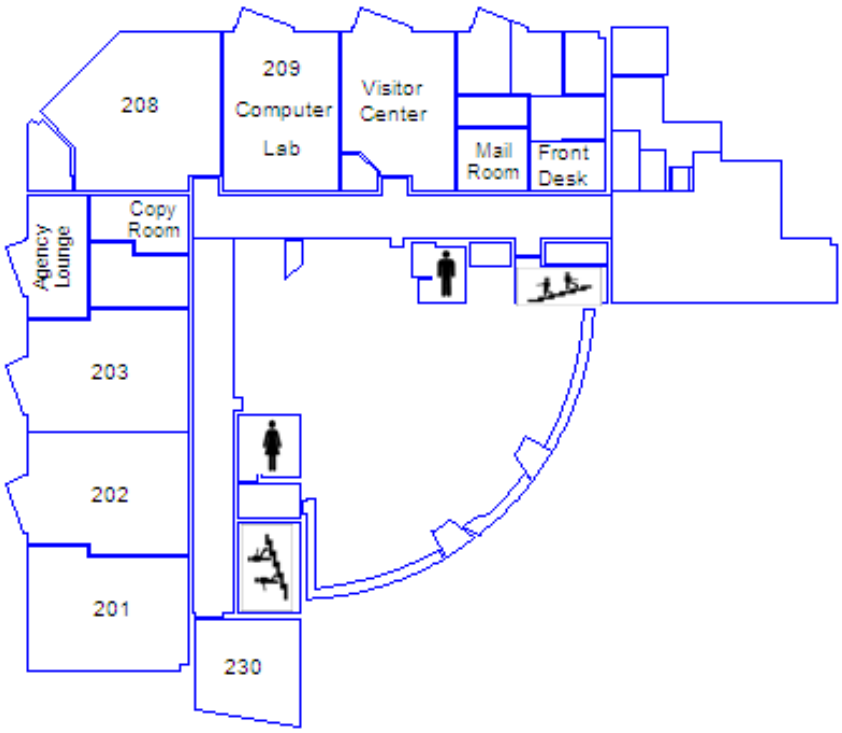
Description	Points
Each Unit	***Not on the BAS; there are no points available for trending.***

Building Floor Plans

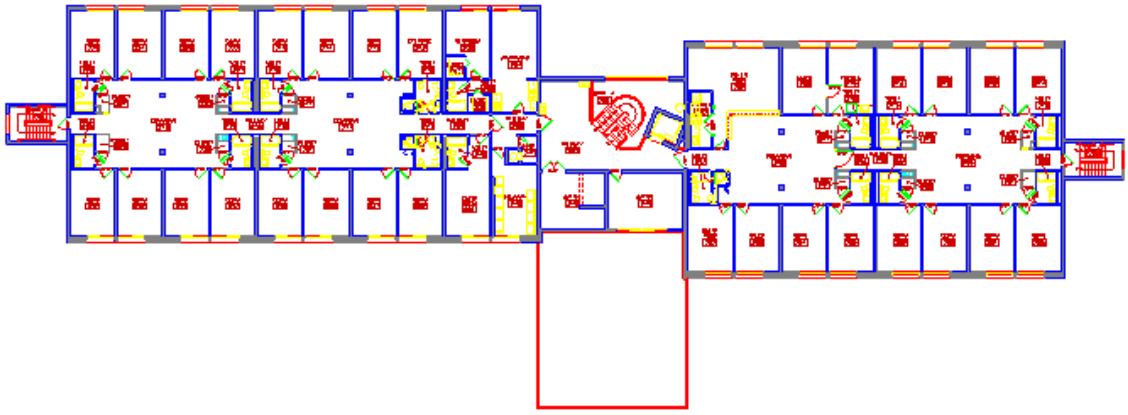
Administration Building – East Wing, 1st Floor

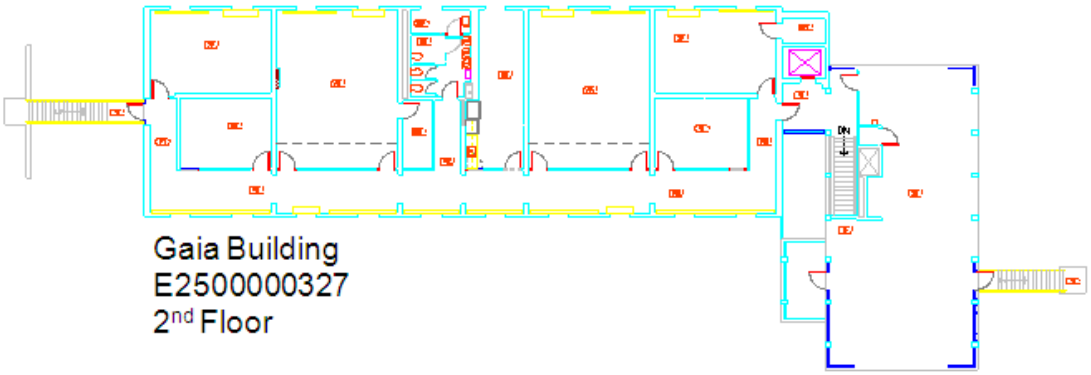


Administration Building – West Wing, 2nd Floor



Delta Dormitory
E2500000427
2nd Floor





Gaia Building
E2500000327
2nd Floor

PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HP	Horsepower
BAS	Building Automation System	HRU	Heat Recovery Unit
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CDWRT	Condenser Water Return Temperature	HWP	Hot Water Pump
CDWST	Condenser Water Supply Temperature	HWRT	Hot Water Return Temperature
CFM	Cubic Feet per Minute	HWST	Hot Water Supply Temperature
CHW	Chilled Water	HX	Heat Exchanger
CHWRT	Chilled Water Return Temperature	kW	Kilowatt
CHWDP	Chilled Water Differential Pressure	kWh	Kilowatt-hour
CHWP	Chilled Water Pump	MA	Mixed Air
CHWST	Chilled Water Supply Temperature	MA Enth	Mixed Air Enthalpy
CRAC	Computer Room Air Conditioner	MARH	Mixed Air Relative Humidity
CV	Constant Volume	MAT	Mixed Air Temperature
DA	Discharge Air	MAU	Make-up Air Unit
DA Enth	Discharge Air Enthalpy	OA	Outside Air
DARH	Discharge Air Relative Humidity	OA Enth	Outside Air Enthalpy
DAT	Discharge Air Temperature	OARH	Outside Air Relative Humidity
DDC	Direct Digital Control	OAT	Outside Air Temperature
DP	Differential Pressure	Occ	Occupied
DSP	Duct Static Pressure	PTAC	Packaged Terminal Air Conditioner
DX	Direct Expansion	RA	Return Air
EA	Exhaust Air	RA Enth	Return Air Enthalpy
EAT	Exhaust Air Temperature	RARH	Return Air Relative Humidity
Econ	Economizer	RAT	Return Air Temperature
EF	Exhaust Fan	RF	Return Fan
Enth	Enthalpy	RH	Relative Humidity
ERU	Energy Recovery Unit	RTU	Rooftop Unit
FCU	Fan Coil Unit	SF	Supply Fan
FPVAV	Fan Powered VAV	Unocc	Unoccupied
FTR	Fin Tube Radiation	VAV	Variable Air Volume
GPM	Gallons per Minute	VFD	Variable Frequency Drive
HD	Hot Deck	VIGV	Variable Inlet Guide Vanes

Conversions
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH